PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

Edited and Issued Monthly by

THE INSTITUTION OF ELECTRICAL ENGINEERS

In Association with

THE PHYSICAL SOCIETY

THE AMERICAN PHYSICAL SOCIETY

THE AMERICAN
INSTITUTE OF ELECTRICAL ENGINEERS

ABSTRACTS 2269–2850

VOLUME 52 **JUNE 1949** NUMBER 618

PRINCIPAL CONTENTS

June 1949

		PAGE
51	**MATHEMATICS**	283
52	**ASTRONOMY. ASTROPHYSICS. GEODESY**	283
53	**PHYSICS**	288
530.1	**Fundamentals**	289
530.12	Relativity	289
530.14	Quantum theory. Theory of particles	289
531	**General mechanics. Mechanics of solids**	291
531.7	**Mechanical measurements**	291
532	**Mechanics of fluids**	292
532.7	**Molecular theory of liquids**	294
533	**Mechanics of gases**	294
533.6	Aerodynamics	295
533.7	**Molecular theory of gases** No abstracts	
534	**Vibrations. Acoustics**	295
535	**Optics. Radiation. Spectra**	299
535.24	Photometry	299
535.31	Geometrical optics	299
535.33/.34	Spectra	299
535.34	Absorption	301
535.37	Luminescence. Raman effect	303
535.4	Interference. Diffraction	304
535.5	Polarized light	305
535.8	Optical instruments	305
536	**Heat**	306
536.7/.8	**Thermodynamics**	308
537.1	**Electricity. Theory. Electrons**	309
537.2	**Electrostatics. Dielectrics**	309
537.3	**Electric conduction. Currents**	311
537.312.62	Superconductivity	312
537.52	**Electric discharges**	313
537.531	**X-rays**	315
537.533/.534	**Cathode rays. Positive rays**	316
537.54	**Discharge tubes. Counters**	318
537.56/.58	**Ionization. Thermionics**	318
537.591	**Cosmic rays**	319
538	**Magnetism**	323
538.3/.5	**Electromagnetism. Electrodynamics**	325
538.6	**Magnetic effects**	326
539.13	**Molecular structure**	327
539.15	**Atomic structure. Isotopes**	329
539.16	**Radioactivity. α-, β and γ-rays**	331
539.17	**Nuclear reactions**	335
539.18	**Atom and molecule beams. Mesons. Neutrons**	339
539.2	**Structure of solids**	342
539.3/.8	**Elasticity. Strength. Rheology**	342
541	**PHYSICAL CHEMISTRY**	344
541.121/.123	**Phase equilibrium**	344
541.124/.128	**Reaction kinetics**	345
541.13	**Electrochemistry**	345
541.14	**Photochemistry**	345
541.18/.182	**Colloids. Disperse systems**	347
541.183	**Adsorption**	347
541.4/.6	**Chemical structure**	347
542.1/.7	**Chemical apparatus**	348
542.9	**Chemical processes**	348
548	**CRYSTALLOGRAPHY**	348
548.7	**Molecular and X-ray crystallography**	349
55	**GEOPHYSICS**	352
551.5	**Atmosphere. Meteorology**	352
57/59	**BIOLOGY**	353
61	**Medical science. Human physiology**	354
77	**PHOTOGRAPHY**	354

The headings printed in bold type will be found in the text. The others may be located by their U.D.C. number.

RELATED SUBJECTS CONTAINED IN SECTION B (ELECTRICAL ENGINEERING ABSTRACTS)

Mechanical testing
Non-destructive testing
Industrial radiography
Corrosion
Electrical and magnetic measurements and instruments
Electronic relays and counters
Automatic control mechanisms
Applied electrochemistry
Photocells
Thermionic tubes
Cathode-ray tubes
X-ray tubes
Induction accelerators
Cyclotrons
Amplifiers
Radio-wave propagation
Mechanical engineering
Heat engines
Illumination
Metallurgy

MATHEMATICS 51

512.3 : 53.081.5

Symbols in the theory of dimensions. *See Abstr.* 2323

517.3

2269. Table of integrals: Part 1, Indefinite integrals. [Integraltafel. Erster Teil: Unbestimmte Integrale.] GRÖBNER, W. AND HOFREITER, N. *Wien, Springer-Verlag, pp.* viii + 166 (1949) *In German*—An extensive list (photographically reproduced) divided into 3 sections: (1) rational integrals; (2) irrational algebraic integrals (incl. elliptic integrals, Weierstrass and Legendre canonical forms, hyperelliptic integrals); (3) transcendental integrals (incl. Weierstrass and Jacobi elliptic functions).

517.93 : 621.3.011.1

2270. Contribution to the theory of the mathematical treatment of non-linear phenomena. ROSENHAMER, H. *Bull. Ass. Suisse Élect.*, **40**, 5–18 (*Jan.* 8, 1949) *In German.*—A method of solving quasi-linear ordinary differential equations is described. The method is applied in a detailed examination of the response to a sinusoidal excitation of a capacitor and resistor in series with a non-linear inductor. Relaxation phenomena and subharmonic oscillation are shown to occur. S. M.

517.933 : 534.1

Topological aspects of forced oscillations. *See Abstr.* 2381

517.947.44

2271. On a new solution of the equation of Fourier. NORDON, J. *C.R. Acad. Sci., Paris*, **228**, 167–8 (*Jan.* 10, 1949) *In French.*—The equation, $a\partial^2\theta/\partial x^2 = \partial\theta/\partial t$, has a solution $\theta = t^m f(z)$, where $z = x(4at)^{-\frac{1}{2}}$, and f is a solution of the differential equation $f'' + 2zf' - 4mf = 0$. Ribaud [Abstr. 203 (1949)] has given a solution of this equation for integral values of $2m$, positive or negative. This solution is now extended to all values of m by the aid of Weber functions. The results are applied to the problem of the plane wall of infinite thickness. G. G.

518.2

2272. A table of roots of $\sin Z = -Z$. ROBBINS, C. I. AND SMITH, R. C. T. Letter in *Phil. Mag.*, **39**, 1004–5 (*Dec.*, 1948).—The real and imaginary parts of the first 10 roots are given. L. S. G.

518.2

2273. Tables of the function $\int_0^z \frac{-\log|1-y|}{y}dy$ with an account of some properties of this and related functions. MITCHELL, K. *Phil. Mag.*, **40**, 351–68 (*March*, 1949).—Two tables are given: (1) values of the integral to 9 decimal places over the range, $z = -1{\cdot}00(0{\cdot}01)1{\cdot}00$; (2) values over the range, $z = 0{\cdot}000(0{\cdot}001)0{\cdot}500$. All integrals of the form $\int \frac{\log(ax+b)}{cx+d}dx$, may be evaluated in terms of the one tabulated. The behaviour of the integral for complex values of z is investigated. L. S. G.

518.5

2274. A note on analog computer design. BRONZO, J. A. AND COHEN, H. G. *Rev. Sci. Instrum.*, **20**, 101–2 (*Feb.*, 1949).—A method is proposed for the simplification of computers designed to solve certain types of partial differential equations, in which the spatial derivatives may be replaced by finite difference expressions. The resulting difference—differential equations are reformulated as a system of linear simultaneous equations by making use of Laplace transforms and matrix notation is introduced. By applying a similarity transformation to the matrix a new system is obtained which lends itself more readily to the construction of an analogue. As an example, the analogue of the equation of the vibrating string with fixed ends is discussed. A.

518.5 : 548.735.4

Electric apparatus for automatic evaluation of Fourier terms. *See Abstr.* 2808

518.5 : 621.316.82 : 621.318.572

2275. Potentiometers for computing circuits. WILLIAMS, W. R. *Electronic Engng*, **20**, 358–60 (*Nov.*, 1948).—When R_0/R_L is small, R_0 and R_L being the resistances of the potentiometer and its load respectively, and the source impedance is negligible, the max. deviation of the potentiometer from its no-load calibration is $4/27 \times ER_0/R_L$, where E is the applied voltage, and this occurs at the setting, $0{\cdot}66R_0$. Practical considerations and limitations arising in circuit design are discussed and an example is given. The effects of resistance variations due to temp. in a Cu-wound source may not be negligible. A brief analysis shows design principles for non-linear potentiometers and a method of handling physically unrealizable conditions is indicated. H. G. M. S. (R)

519.21 : 537.54

Statistical theory of dead-time losses in a counter. *See Abstr.* 2559

519.24/.287

2276. A simple technique for producing random sampling numbers. HAMAKER, H. C. *Proc. K. Ned. Akad. Wet.*, **52** (*No.* 2) 145–50 (1949) *In English.*—Describes a simple dice-throwing technique for producing random sampling numbers, together with the results of tests applied to prove the randomness of the procedure. A.

ASTRONOMY . ASTROPHYSICS . GEODESY 52

521 : 539.17 : 629.19

The atomic rocket. *See Abstr.* 2705–8

521.03/.04 : 523.12 : 523.8

Corpuscular instability of stars. *See Abstr.* 2283

521.032 : 523.84

Secular mass loss of stars as factor in evolution. *See Abstr.* 2303

521.1 : 523.2 : 531.35 : 629.19

2277. The dynamics of space-flight. CLARKE, A. C.

J. Brit. Interplan. Soc., **8**, 71–84 (*March*, 1949).—The dynamics of escape from the earth's gravitational field and of movement between the planets is discussed by means of potential diagrams and the projection velocities needed for typical journeys between earth, moon and inner planets are tabulated.

522.21

2278. Optics of the 200-inch Hale telescope. ANDERSON, J. A. *Publ. Astr. Soc. Pacif.*, **60**, 221–4 (*Aug.*, 1948).—Describes the main and auxiliary mirrors, their construction, polishing and method of testing. The advantages of this instrument are discussed. E. G. M.

522.21 : 535.317

New wide-angle cata-dioptric astronomical telescopes. *See Abstr.* 2411

522.26

2279. Engineering aspects of the 200-inch Hale telescope. RULE, B. *Publ. Astr. Soc. Pacif.*, **60**, 225–9 (*Aug.*, 1948).—Describes the preliminary work on test models previous to the making of the full-size instrument. Details the engineering innovations, particularly the yoke-type polar axis and its oil pad lubrication system, and the complicated arrangements for accurate setting and driving of the telescope. E. G. M.

522.33

2280. A proposed "mirror transit-circle." ATKINSON, R. D'E. *Mon. Not. R. Astr. Soc.*, **107** (*No.* 3) 291–307 (1947).—It is proposed to replace the moving telescope of the classic transit circle with a moving plane mirror in which reflected star images are observed through fixed telescopes in the meridian. The advantages and disadvantages of the method are listed. Extra-meridian observations of declination from the roof-shaped rear face of the mirror can be used to obtain fundamental azimuths more quickly than by the conventional method. Transits occur nearly horizontally over a range of declinations fairly near the zenith. An expression is derived for the collimation, which is radically different from collimation with a telescope transit; and methods of obtaining pivot errors and personal equations are derived. Possible features of the optical and mechanical design are indicated. A. HU.

523

2281. Morphological astronomy. ZWICKY, F. *Observatory*, **68**, 121–43 (*Aug.*, 1948).—It is proposed to solve large-scale astronomical problems by selection from a schematic perspective over all conceivable solutions. The basic elements of a morphological analysis of astronomy are discussed with special reference to recent developments at Pasadena. The photoelectronic telescope and mosaic objective gratings are described and also a proposed electronic image-stabilizer to reduce atmospheric tremors. The work of the 18 in Schmidt telescope on nebular clusters, on supernovae and on possible intergalactic stars is reviewed, and a revised luminosity function of the local group of galaxies is given. With the 48 in Schmidt telescope it should be possible to observe neutron stars acting as gravitational lenses. These stars may, in theory, produce reversals of time. A new expansion-luminosity relation for novae and supernovae is established and the possibility that cosmic rays are generated in supernovae is discussed. The importance of rockets for astronomical research and exploration is emphasized. A. HU.

523.11 : 530.12

2282. A model of the universe and the origin of stars. LUDWIG, G. AND MÜLLER, C. E. F. *Arch. Math.*, **1** (*No.* 1) 80–2 (1948) *In German.*—See Abstr. 3077 (1948). R. A. N.

523.112 : 530.12

A nonhomogeneous cosmological model. *See Abstr.* 2327

523.12 : 523.8 : 521.03/.04

2283. Corpuscular instability of stars. KRAT, V. *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 5) 875-8 (1949) *In Russian.*—From the equation of the stationary state of a star, previously given by the author [*ibid.*, **55** (*No.* 3) (1947)], it is possible to estimate the continuous loss in fast electrons and protons. The assumed case when the protons are not affected by gravity is investigated. This produces what the author terms *corpuscular instability* of the star, i.e. continuous loss of matter. Theory gives a very simple relation for the limiting radius of instability, viz. $m/TR = 7{\cdot}0 \times 10^{15}$. It can easily be shown that for given m, R, and T, corpuscular instability, as a special case of the stationary state, may occur instantly. As an example, the calculation is carried through for the sun, and the upper limit of its relaxation time is found as 10^8 years. On certain assumptions on the constants of the equation, however, a stationary state of the star could never materialize, but the positive charge would rise indefinitely and the relaxation time accordingly be reduced by several orders of magnitude. The conclusion to be drawn is that whenever the radius of instability is surpassed by a star, this star must disintegrate within a cosmologically short period ($<10^8$ yr). Thus an upper limit for a star's radius is established. The value found is $R = 3{\cdot}16$ astr. units (for $T = 6\,000°$ and m = mass of sun). Interesting comparisons between earlier stages of the sun's development and the observed conditions of the Cepheid stars are drawn, from which it appears that the latter are in a near-critical state. A consequence of this is the observable fact that the stars of this class are progressively depleted of H, if at a very slow rate. A further series of conclusions is arrived at regarding the critical radii and possible maximum temps. of small celestial bodies (e.g. of the size of earth and moon). B. F. K.

523.14 : 523.854.1

2284. Galactic noise. WOOLLEY, R. V. D. R. *Mon. Not. R. Astr. Soc.*, **107** (*No.* 3) 308–15 (1947).—Electron velocities in interstellar space correspond to temperatures $\sim 12\,000°$ close to early-type stars, where H is mainly ionized, but only to 1 000° where metallic ions outnumber H ions. Galactic radiation in the radio region at the strength observed must come from the "hot" regions, probably from regions where the H concentration exceeds 1 cm^{-3}. If the observed noise is due to free-free transitions, the areas where it originates should show bright H emission. A. HU.

523.165 : 523.854.2

2285. Galactic noise and the plane of the galaxy. NORTHCOTT, R. J. AND WILLIAMSON, R. E. *J. R. Astr.*

Soc. Can., **17**, 269–79 (*Nov.–Dec.*, 1948).—A determination of the galactic plane by comparing the radio-noise observations of Jansky, Reber, Sander, and Hey, Parsons and Phillips.

523.4

2286. The relation of cohesion to Roche's limit. JEFFREYS, H. *Mon. Not. R. Astr. Soc.*, **107** (*No.* 3) 260–2 (1947).—The classic Roche theory is extended to a solid satellite. If its diameter is < the unexpectedly large critical value of 220 km, a solid satellite will not break up close to the surface of the earth. The asteroids cannot have been formed by the close approach of a single object to Jupiter; nor can Saturn's rings have been formed by tidal disruption of a solid satellite. A. HU.

523.43

2287. A study of the polarisation of the solar light reflected from the planet Mars. DOLLFUS, A. *C.R. Acad. Sci., Paris*, **227**, 331–3 (*Aug.* 2, 1948) *In French.*—Gives results of observations made in early 1948 from the Pic du Midi with a 24 in telescope with polarimeter. Four effects contribute and each has been measured and a value derived. E. G. M.

523.46

2288. The effects of collisions on Saturn's rings. JEFFREYS, H. *Mon. Not. R. Astr. Soc.*, **107** (*No.* 3) 263–7 (1947).—Collisions between meteoritic particles in Saturn's rings would annihilate the velocities normal to their plane and the radial velocities in < a year, and thus produce thin rings. Further dissipation due to differences in orbital period would widen the rings until the spacing was enough to avoid collisions, this effect taking place in a time cosmogonically short ($\sim 10^6$ yr for 1 cm particles). The stability criteria of Maxwell and of Goldsbrough are criticized. A. HU.

523.5 : 551.510.535 : 531.552

Ballistics of the upper atmosphere. *See Abstr.* 2832

523.531

2289. Meteors. PRENTICE, J. P. M. *Rep. Phys. Soc. Progr. Phys.*, **11**, 389–402 (1946–47).—Current knowledge gained from visual meteor observations is reviewed. Annual and diurnal variations in the number of observed meteors are discussed, and methods of determining radiants, velocities and paths in the atmosphere are described. Hyperbolic velocities are believed to be illusory. A. HU.

523.6 : 523.532

2290. Comets and meteor-streams. PORTER, J. G. *Rep. Phys. Soc. Progr. Phys.*, **11**, 402–9 (1946–47).—Characteristics of cometary orbits are discussed and compared with those of meteor streams. Observed cases of disruption of a comet have always given $\geqslant 2$ comets, not a meteor stream. The effect of perturbations on a swarm of particles is to distribute them unevenly round the orbit. Even for a spectacular shower like the 1833 Leonids the distance between particles must have been ~ 20 km. A table showing agreement between comets and meteor showers as regards similarity of orbit, periodic return, advance or regression of the node and daily motion of the radiant gives only 6 accordances out of 60 cases in which comets can come within 0·1 astr. unit of the earth. A. HU.

523.67 : 523.57 : 523.51

2291. Spectroscopic observations on comets, meteors and meteorites. PEARSE, R. W. B. *Rep. Phys. Soc. Progr. Phys.*, **11**, 410–14 (1946–47).—The spectra of comets (head and tail) show mostly band systems excited by fluorescence due to sunlight. Meteor spectra show atomic lines comparable with those obtained by furnace excitation at 1 700–3 300°K. Spectroscopic study of fallen meteorites is consistent with the view that comets and meteors are composed of the same material as meteorites. A. HU.

523.72

2292. Solar radio-noise of 200 Mc/s and its relation to solar observations. ALLEN, C. W. *Mon. Not. R. Astr. Soc.*, **107** (*No.* 4) 386–96 (1947).—Daily means of steady noise flux and of hourly frequency of bursts are plotted against sunspot and geomagnetic data. Both are closely related to the central meridian passage of spots, but some large spot groups do not produce solar noise. No close relation is found with the emission of solar corpuscles causing geomagnetic storms, except that noise bursts tend to accompany flares. Evidence is cited for the view that the source of the noise is high in the corona. A. HU.

523.743

2293. New observations on the darkening of the solar disc and the continuous radiation from its centre. CANAVAGGIA, R. AND CHALONGE, D. *C.R. Acad. Sci., Paris*, **223**, 132–4 (*July* 17, 1946) *In French.*—The observations were made at the Observatory of Haute-Provence in August, 1943, and August, 1945. They are used to calculate the coefficients, A_λ, B_λ, C_λ in the formula $A_\lambda + B_\lambda \cos\theta + C_\lambda \cos^2\theta$, for the darkening, where λ is the wavelength. The distribution, with λ, of the energy from the centre of the disc is also calculated. L. S. G.

523.746

2294. Magnetic and electric phenomena in the sun's atmosphere associated with sunspots. GIOVANELLI, R. G. *Mon. Not. R. Astr. Soc.*, **107** (*No.* 4) 338–55 (1947).—The magnetic field in the solar atmosphere near a single spot or a bipolar group, and the electric field resulting from changes in this field, are computed both for a non-conducting and for an ionized static atmosphere. The propagation of the electromagnetic field is sufficiently rapid if the conductivity is negligible or if it decreases perpendicularly to the magnetic field. If there is no other magnetic field, the current density is small since the conductivity in the direction of the electric field is low. If a general magnetic field exists inclined to the solar surface, currents can circulate either through neutral points in the combined magnetic field or through sunspots. A. HU.

523.746

2295. The predominance of sunspots on the east of the central meridian and the inclination of their axes to the west. ROMAÑA, A. AND TORROJA MENÉNDEZ, J. M. *Urania*, **32**, 1–23 (*Jan.–June*, 1948) *In Spanish.*—A discussion of the effect discovered by Maunder in 1907. Three lines of approach indicate its reality: the number of spots also appears to increase from the edge to the centre of the sun. It is concluded that the effect is due to the inclination of the spots' axes to

the normal cutting the solar surface. This angle is ascertained, by two different methods, to be $1° 55' \pm 10'$ W. Comparison with different solar cycles suggests a periodic variation of this angle of amplitude 3° around a mean of 1° 15 W, of a duration of 7 or 8 solar cycles.

523.746

2296. Magnetic moments of sunspots. BROXON, J. W. *Phys. Rev.*, **75**, 606–11 (*Feb.* 15, 1949).—Simple approximate representations of the magnetic fields of sunspots by dipoles or ring currents are considered, and expressions deduced for the magnetic moment of a sunspot in terms of its area and its maximum central magnetic field strength. These are extended to include sunspot groups, and a function (SS-MM) is defined as the arithmetical sum of the equivalent moments of all visible groups. Statistical treatment by Chree's method of superposed epochs provides some indication of a 27-day interval between recurrences of fluctuations in SS-MM. A.

523.746 : 537.591.5

Sunspot magnetic moments and cosmic radiation. *See Abstr.* 2595

523.75 : 523.72

2297. Brightness variations of the solar corona. VAN DE HULST, H. C. Letter in *Nature, Lond.*, **163**, 24 (*Jan.* 1, 1949).—Previous often-quoted work by Baumbach [*Astronomische Nachrichten*, **263**, 121 (1937)] gave electron densities N_e of the solar corona. Two factors which were neglected are now considered on the basis of recent developments: (1) only one component, K, of the sun's surface brightness appears to be due to electron scattering, while in the outer corona the remaining F-component (probably caused by diffraction through interplanetary dust) predominates; (2) brightness and shape of the corona change with the 11-year solar cycle. The author obtains the ratios $K/(K + F)$ from observations of the depth of the Fraunhofer lines and of polarization, and also derives the change in brightness between max. and min. phase. Applying Baumbach's method he tabulates for distances from the sun's centre of 1 to 5 radii the values of N_e for max., min. at equator, and min. at pole. N_e varies by a factor 1·78 during the cycle; the corresponding factor for the opacity of the corona for radio waves varies as its square, i.e. by about 3. It has previously been found that the largest brightness variation occurs at a wavelength of about 1 m. The author shows that this can be accounted for by the above changes of the opacity. He finally suggests that the sun may be considered as a variable star with an 11-year period, varying most strongly near $\lambda = 50$ cm with an intensity factor of about 2 during the cycle. A. B.

523.77 : 535.334

2298. Forbidden lines of ionized iron in the solar spectrum. CABANNES, J. AND DUFAY, J. *C.R. Acad. Sci., Paris*, **226**, 2032–4 (*June* 21, 1948) *In French.*—Evidence based on the Utrecht photometric atlas and Rowland's tables strongly suggests the presence of forbidden lines of Fe II in the Fraunhofer spectrum. Agreement of faint solar lines with lines of the multiplets a^6D–a^6S, a^4F–a^4G and a^6D–b^4F, where not masked by known solar lines, are too numerous for chance coincidences. D. L. E.

523.77 : 535.334

2299. New solar lines in the spectral region 1·52–1·75 μ. GOLDBERG, L., MOHLER, O. C. AND MCMATH, R. *Astrophys. J.*, **109**, 28–41 (*Jan.*, 1949).—Accurate wavelengths and percentage central absorptions are given for nearly 300 new solar lines from high resolution tracings obtained with a spectrometer and Cashman PbS cell. In addition to lines from neutral atoms of C, Mg, Al, Si, Fe, Mn, Ni, some members of the H Bracket series have been identified; also a Na I doublet from the $4s$–$4p$ transition. D. L. E.

523.77 : 535.343.4 : 551.510.4

2300. Telluric bands of CH_4 in the solar spectrum. MCMATH, R., MOHLER, O. C. AND GOLDBERG, L. *Astrophys. J.*, **109**, 17–27 (*Jan.*, 1949).—Four molecular band systems at 1·66, 2·20, 2·32, 2·37 μ, discovered in mapping the i.r. solar spectrum with an all-reflecting Pfund type spectrometer in conjunction with a sensitive PbS cell, are identified as CH_4 in the earth's atmosphere with an abundance of 1·2 parts in 1 000 000 by mass and a temperature of −37°C. D. L. E.

523.774 : 535.338.334

2301. Theoretical contours of absorption lines. HARRIS, D. L., III. *Astrophys. J.*, **109**, 53–65 (*Jan.*, 1949).—Using the most recent data on the variation of the relevant physical parameters within the sun's atmosphere, theoretical profiles of the Na D_1 and D_2 lines have been constructed for points on the solar disc corresponding respectively to the centre ($r = 0$) and $r = 0{\cdot}97R$. Theoretical and observed profiles agree satisfactorily when an atomic abundance value, $N = 10^{18}$, for the ground state, is used to compute the former. D. R. B.

523.774 : 535.342

2302. The Fraunhofer lines of the solar spectrum. MINNAERT, M. G. J. *Mon. Not. R. Astr. Soc.*, **107** (*No.* 3) 274–90 (1947).—Modern methods of photographic photometry are described as applied to the determination of line profiles in the Utrecht solar atlas. Recent theoretical improvements in interpreting the observed profiles emphasize the importance of van der Waals' forces in collision damping and of continuous absorption by H^- ions. Future problems chiefly concern profile variations over the disc, the derivation of curves of growth for individual lines, and the determination of relative abundances of the elements. A. HU.

523.84 : 521.032

2303. Secular mass loss of stars as a factor in evolution. MARTINOV, D. YA. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 7) 1149–52 (1948) *In Russian.*—The secular mass loss of stars by radiation was hitherto regarded as an insignificant factor in the evolution of binary systems, important only for very massive stars. A star loses mass at an incomparably higher rate by systematic ejection of matter at the nova stage, the Wolf-Rayet stage, etc., the flowing off of matter along the equator in close binary systems, and corpuscular ejection occurring even with comparatively cold stars such as the sun. This material loss is accompanied by a loss in angular momentum which results in a slowing down of the

rotation. Combining this with the assumption that H is the element most probably lost, the ageing of a star from a hot massive to a cold star can be predicted on comparatively simple theories. To explain how fast revolving stars are formed, a very rapid compression of gravitational character of a cold giant star with slow revolution has to be imagined. In the evolution of binary systems a retardation of the rotation owing to tidal friction occurs. Assuming that synchronism of axial and orbital revolution has been achieved, the orbital period will be lengthened owing to the mass loss, whilst the revolution of the components is slowed down on account of the loss of angular momentum. The second process develops more quickly, this leading to the axial being slower than the orbital rotation. B. F. K.

523.84.035.92

2304. On the light curves of Cepheid variables. PAYNE-GAPOSCHKIN, C. *Astr. J.*, **52**, 218–26 (*July*, 1947).—Details the importance of, and previous work on, the relation between period and form of light curve of these variable stars. A mathematical analysis follows to deduce the first 5 harmonics of the light curves, using observations which fall into 5 groups, much of which is from the Harvard Observatory. The main pattern and its peculiar discontinuities is discussed. It is suggested that differences in the composition of the stars are the most important reason for variation in the pattern of the light curve. Z. G. M.

523.841.1 : 523.87

2305. On the spectrum of Nova Serpentis 1948. BLOCH, M. *C.R. Acad. Sci., Paris*, **227**, 333–5 (*Aug.* 2, 1948) *In French.*—Spectra taken 2–3 months after discovery show the nova in the nebular stage. A list of observed emission lines for several elements indicates the simultaneous presence of very different degrees of ionization. D. L. E.

523.841.11 : 523.872

2306. A spectrophotometric study of maxima in the emission lines of Nova Herculis 1934. ALY, M. K. *Mon. Not. R. Astr. Soc.*, **107** (*No.* 3) 316–30 (1947).—Intensity ratios of the red and violet components of 16 emission lines during the 4 months following the outburst of the nova are correlated with the light curve. The results are consistent with the emission of hot jets of matter of different composition streaming out in opposite directions and forming stratified layers later. A. HU.

523.841.9

2307. The problem of eclipsing binaries. LEVITT, I. M. *J. Franklin Inst.*, **247**, 7–24 (*Jan.*, 1949).—An introduction to the calculation from the light-curve of the geometrical elements of the idealized eclipsing binary system in which the stars present uniformly illuminated discs, and pursue circular orbits. M. W. O.

523.841.9 : 523.854.12 : 535.51

2308. Polarization of radiation from distant stars by the interstellar medium. HILTNER, W. A. *Nature, Lond.*, **163**, 282–3 (*Feb.* 19, 1949).—Gives results of measures on spectroscopic binaries, made in an attempt to detect polarization of emitted continuous radiation. The results quoted point to the polarization arising not in the stellar atmospheres, but in the intervening interstellar medium. Further observations are in progress. E. G. M.

523.841.9 : 523.854.12 : 535.51

2309. Polarization of light from distant stars by interstellar medium. HILTNER, W. A. *Science*, **109**, 165 (*Feb.* 15, 1949).—Note on the detection of polarization in the light of some distant eclipsing binaries which is not correlated with the phase of the binary motion, and is interpreted as being due to interstellar matter. M. W. O.

523.841.9 : 523.854.12 : 535.51

2310. Observations of the polarized light from stars. HALL, J. S. *Science*, **109**, 166 (*Feb.* 15, 1949).—Hiltner's results [Abstr. 2309 (1949)] are confirmed by a different method using a "flicker" device and it is shown that the polarization is independent of wavelength. M. W. O.

523.851.2

2311. On the theory of globular star-clusters. FINLAY-FREUNDLICH, E. *Mon. Not. R. Astr. Soc.*, **107** (*No.* 3) 268–73 (1947).—The structure postulated [Abstr. 3057 (1946)] for a globular cluster can only be an intermediate phase. Dynamical considerations show that any spherical system of stars contracting gravitationally will pass through a quasi-stationary state in which its internal structure resembles that to be expected if hydrostatic equilibrium had been attained. A. HU.

523.852.3 : 523.161

2312. Note on the condensation of interstellar material into stars. HOYLE, F. *Mon. Not. R. Astr. Soc.*, **107** (*No.* 4) 334–7 (1947).—The considerations determining the fraction by mass of a nebula that is condensed into stars are discussed. The criterion deduced suggests that the elliptical nebulae and the nuclei of disc-shaped nebulae are almost wholly condensed, whereas the outer regions of the latter are largely uncondensed. Where interstellar material is absent, the bright stars cannot replenish their H stores; thus the age of the nebulae can be determined from the luminosities of the brightest stars in their nuclei. This method gives an age between 2×10^9 and 10^{10} yr for the age of the nebulae. A. HU.

523.877

2313. Note on non-static stellar models. HOYLE, F. AND LYTTLETON, R. A. *Mon. Not. R. Astr. Soc.*, **107** (*No.* 3) 246–52 (1947).—The evolution of stellar models involving discontinuities of mean molecular weight is examined, and Ledoux's discussion [Abstr. 1712 (1947)] is shown to be too restrictive. A further possibility, viz. that the polytropic index changes from 1·5 to >3·25 at the interface between interior and exterior, leads to an adiabatic oscillation, confined mainly to the outer region, that is tentatively identified with the pulsation of a long-period variable. A. HU.

523.877

2314. Note on the origin of white dwarfs. HOYLE, F. *Mon. Not. R. Astr. Soc.*, **107** (*No.* 3) 253–9 (1947).—Difficulties arising from Eddington's theory [Abstr. 3579 (1939)] of white dwarfs are considered. It may be that the Galaxy was originally entirely H and gave rise to white dwarfs devoid of C and N. Alternatively, white dwarfs may be the product of nova and super-

nova outbursts and may gain their high H content by accretion subsequently. The chronological history of the Galaxy and in particular the synthesis of heavy elements are traced on both hypotheses. A. HU.

523.877

2315. On the practical application of the variational method to model stellar atmospheres. KOURGANOFF, V. *C.R. Acad. Sci., Paris*, **228**, 300–2 (*Jan.* 24, 1949) *In French.*—See Abstr. 1757 (1948). The method is reconsidered with special reference to local thermodynamic equilibrium. R. A. N.

523.877

2316. Exact curves of growth for the formation of absorption lines according to the Milne-Eddington model. I. WRUBEL, M. H. *Astrophys. J.*, **109**, 66–75 (*Jan.*, 1949).—Theoretical curves of growth connecting equivalent width and atomic abundance are constructed on the more accurate Milne–Eddington stellar model for 6 values of $\log a$, from -3 to -1, and for 4 values of $B^{(0)}/B^{(1)}$ from 1/3 to 10/3. Chandrasekhar's exact solution of the transfer equation has been used, together with Hjerting's values of the line absorption coefficient. Detailed tabulations are given to facilitate computation. D. R. B.

523.877

2317. The spectrum of Epsilon Aurigae 1946–1948. WRIGHT, K. O. AND VAN DIEN, E. *J. Roy. Astr. Soc. Can.*, **43**, 15–33 (*Jan.–Feb.*, 1949).—Equivalent widths in high-dispersion spectra of the ε Aurigae system are measured, and analysed from consideration of curves-of-growth. The results for Fe I lines give turbulent velocities, the values of which (between 1 and 30 km/sec) are almost independent of the model used for the calculation of the theoretical curve-of-growth, but show a dependence of velocity on excitation potential. The possibility of this result being due to observational selection is believed eliminated, but the suggested alternative mechanism of departures from thermodynamic equilibrium is not examined. Line-profiles could not give confirmation of the interpretation as they are broadened, supposedly by either rotation or large-scale jet motions. An excitation temp. of $\sim 6\,000$°K calculated for a static model is believed to be of the right order of magnitude. Differences between normal and "forbidden" lines indicates some radiation dilution in an extended atmosphere. M. W. O.

523.877

2318. The oscillations of a rotating star. COWLING, T. G. AND NEWING, R. A. *Astrophys. J.*, **109**, 149–58 (*Jan.*, 1949).—Rayleigh's principle is generalized to apply to a rotating system, and is used to obtain approximations to the periods of oscillation of a rotating star. Ledoux's formula for radial oscillations [Abstr. 2459 (1946)] follows if uniform dilation is assumed. More exact numerical results are obtained in certain cases. R. A. N.

523.877 : 523.852.22

2319. Multiplet intensities for the nebular lines ^4S–^2D of O II. ALLER, L. H., UFFORD, C. W. AND VAN VLECK, J. H. *Astrophys. J.*, **109**, 42–52 (*Jan.*, 1949).—Previous theoretical calculations of the relative intensities of the O II transitions $1s^22s^22p^3\ ^4S_{3/2} - {}^2D_{5/2}$ and $1s^22s^22p^3\ ^4S_{3/2} - {}^2D_{3/2}$ observed in low-excitation nebulae are refined by including the effects of spin-spin interaction, assuming that collisional de-excitation is predominant, and ignoring configuration interaction. The radial integral η is estimated by the self-consistent field method, and control on the value of η obtained by calculating the effect on the multiplet splittings $^2D_{5/2}-{}^2D_{3/2}$ and $^2P_{3/2}-{}^2P_{1/2}$ of coupling one spin with the orbit of another. Experimental intensity ratios are re-examined for 11 planetary nebulae, and the agreement between theory and experiment is found to be much improved on that of previous work. Residual discrepancies are believed due, on the one hand, to variations in electron density in the nebulae, and on the other to uncertainties in the Hartree wave functions. M. W. O.

523.877 : 533.15

2320. Solution of the transport equation for the cylindrical case. GRATTON, L. *Nuovo Cim.*, **5**, 68–77 (*April*, 1948) *In Italian.*—The mascropic equation of diffusion in an homogeneous medium for the case of axial symmetry (problem of total absorbing rod) is solved in 1st and 2nd approximation using an expansion in series of tesseral harmonics. Further numerical computations are needed in order to show the convenience of applying to actual problems the present solution instead of the solution for the spherical symmetry. A.

529.786 : 621.396.616

2321. Atomic clock. *Rev. Sci. Instrum.*, **20**, 141 (*Feb.*, 1949).—The clock is based on the resonant absorption of ammonia gas. Radio frequency energy obtained by multiplying the frequency of a quartz oscillator is passed through the gas and an error voltage is generated if the frequency differs from the natural absorption frequency of the gas. This voltage corrects the frequency of the quartz oscillator which is then divided to 50 cycles to drive a mains clock dial. A constancy of frequency of 1 part in 20 million has been obtained. L. E.

PHYSICS 53

53.081 : 621.3.081.5

2322. Three-dimensional electric units, QLT and ILT. WARBURTON, F. W. *Amer. J. Phys.*, **16**, 435–43 (*Nov.*, 1948).—After outlining the close relation between the recently-standardized absolute electrical units and the m.k.s. system, the article gives a detailed discussion of the advantages to be obtained from modernized 3-dimensional c.g.s. and m.k.s. systems. It is shown that the fourth supposedly-fundamental unit, the so-called "permeability of space," is not necessary. By choosing either a charge-length-time (QLT) or a current-length-time (ILT) system, in conjunction with numerical conversion factors to which no physical attributes need be given, the concepts of mass, force and energy can be expressed in electrical terms. Fractional exponents

are eliminated from dimensional equations. It is suggested, in passing, that the field vector B, expressed in webers/m^2 should be named the "riemann," in recognition of its association with vector potential.

B. H. (R)

53.081.5 : 512.3

2323. More accurate symbolism in the theory of dimensions. SHTANDEL, A. E. *J. Tech. Phys., USSR*, **18**, 1221–9 (*Sept.*, 1948) *In Russian.*

53.084 : 681.2 : 621.385.832

2324. A technique for the making and mounting of fine mesh screens. LAW, H. B. *Rev. Sci. Instrum.*, **19**, 879–81 (*Dec.*, 1948).—A new process has been developed for making fine mesh metal screens from glass masters. The master contains grooves corresponding to the screen wires. Metal is sputtered on the master, rubbed off the surface and the remaining metal in the grooves plated to form the screen. Screens from 200 to 1 500 meshes/in have been made with $> 50\%$ transmission. A method of mounting the screens on a ring and subsequent tightening by heat treatment is described. A.

FUNDAMENTALS 530.1

530.12

2325. The anisotropy of the ether around an exact, spherically symmetric, energy focus in uniform translation. DIVE, P. *C.R. Acad. Sci., Paris*, **223**, 232–4 (*July* 29, 1946) *In French.*—The author's theory, based on the postulate of a "universal" time, is used to examine the geometrical structure of the ether. The results imply ellipsoidal wave propagation of type II [See Abstr. 1493 (1946)]. R. A. N.

530.12

2326. Action as a coordinate of space. I. RUMER, G. B. *J. Exp. Theor. Phys., USSR*, **19**, 86–94 (*Jan.*, 1949) *In Russian.*—It is shown that the problem of relativistic mechanics (classical as well as quantum-mechanical) of the motion of a point in gravitational and electro-magnetical fields is equivalent to the optical (geometrical as well as undulatory) problem of ray propagation in a 5-space of Riemann co-ordinates, time and action. B. F. K.

530.12 : 523.11

A model of the universe. *See Abstr.* 2282

530.12 : 523.112

2327. A nonhomogeneous cosmological model. OMER, G. C., JR. *Astrophys. J.*, **109**, 164–76 (*Jan.*, 1949).—A spherically symmetrical model of the universe is constructed on the basis of the general theory of relativity. The model has more free parameters than the usual homogeneous models of relativistic cosmology, and a satisfactory fit to the observational data can be obtained on the assumption that the earth is near the centre of a spherically symmetrical distribution of matter with radially increasing density. H. B.

530.12 : 535.1

2328. On the ether-drift and the internal and external Lorentz transformations. GIÃO, A. *C.R. Acad. Sci., Paris*, **226**, 2051–3 (*June* 21, 1948) *In French.*—In the author's unitary theory involving internal and external space-time metrics [Abstr. 2018, 2085 (1947)], light rays are not in general null-geodesics of the internal metric. A strong electric field will involve a slight anisotropy in the velocity of light in vacuo. It is conjectured that this may explain Miller's observations of a small ether-drift [Abstr. 3366 (1933)]. R. A. N.

530.12 : 537.56

The ionization produced by a particle with spin in the relativisitic limit. *See Abstr.* 2568

530.14

2329. The meaning of mass and its definition in kinematic relativity. CAUSSE, M. *C.R. Acad. Sci., Paris*, **228**, 370–2 (*Jan.* 31, 1949) *In French.*—The definition of mass and the equations of free motion in kinematic relativity [Abstr. 2067 (1936)] are criticized and a suggestion made for modifying the former as well as the definition of force. G. J. K.

530.14 : 535.14

2330. Relativistic covariance in the theory of the super-quantised photon. DE BEAUREGARD, O. C. *C.R. Acad. Sci., Paris*, **228**, 296–8 (*Jan.* 24, 1949) *In French.*—Modifications of de Broglie's theory are discussed to make it covariant in the manner of Schwinger–Tomonaga. G. J. K.

530.14 : 538.3

Behaviour of particle of very small mass at relativistic speeds in a magnetic field. *See Abstr.* 2619

530.14 : 539.18

2331. Elementary particles and the principle of reciprocity. BORN, M. Letter in *Nature, Lond.*, **163**, 207–8 (*Feb.* 5, 1949).—The properties of an elementary particle are determined if the Lagrangian density of the corresponding field is known. It is proposed to restrict the possible Lagrangians by postulating that they should be eigenfunctions of an operator which is symmetric in the space-time coordinate and energy-momentum operators. For a scalar field this operator is $x^k x_k + p^k p_k$ ($k = 1, 2, 3, 4$), and the eigenfunctions are, apart from an exponential factor, the Laguerre polynomials of argument $P = p_k p^k$. On quantization, the scalar fields determined by such a Lagrangian describe the co-existence of particles with different rest masses, the numerical values of which are related to the zeros of the corresponding polynomial. H. MCM.

530.145

2332. Extension of the fundamental identities of mathematical physics to spinors. DE DONDER, T. AND VAN ISAKER, J. *Bull. Acad. R. Belge Cl. Sci.*, **34** (*No.* 4) 317–24 (1948) *In French.*—Details are given of the derivation of field equations for fields involving spinors, by a variation principle previously published [Abstr. 3006 (1947)]. G. J. K.

530.145

2333. Why not discard the spinor calculus? FISCHER, O. *Phil. Mag.*, **39**, 878–84 (*Nov.*, 1948).—The Pauli and Dirac spin matrices are discussed and their use in the Dirac equations pointed out. The development of the spinor calculus is traced briefly and it is suggested that by a return to a "world" system of relativity [Abstr. 1500 (1939), 2577 (1940)]

the generalized Schrödinger equation may be derived in a more natural and simple synthetic form. L. S. G.

530.145

2334. Quantized field theories and the principle of reciprocity. GREEN, H. S. Letter in *Nature, Lond.*, **163,** 208–9 (*Feb.* 5, 1949).—A method is given for the quantization of fields derived from Lagrangians containing higher derivatives of the field potentials, which is simpler than the corresponding methods of Chang [Abstr. 2036 (1946), 1428 (1948)], and de Wet [Abstr. 47 (1949)]. The result of applying the method to Born's self-reciprocal Lagrangians is briefly stated. H. McM.

530.145

2335. The indefinite metric in relativistic quantum mechanics. LE COUTEUR, K. J. *Proc. Roy. Soc. A*, **196,** 251–71 (*March*, 1949).—Many problems of relativistic quantum mechanics cannot be treated by working with a positive definite metric in the vector space of the fully quantized system. It is shown that, independently of the signs of energy and charge in the *c* number theory, any relativistic wave equation can be quantized and interpreted in terms of positive energies by use of an indefinite metric of suitable signature. A powerful method of obtaining positive definite transition probabilities from an indefinite metric is introduced and the concept of "negative probability" is entirely avoided. The transition probabilities are defined as the squared matrix elements of a unitary matrix T, which is obtained from the solution of the Schrödinger equation by means of a special transformation. These techniques make it possible to treat relativistic wave equations which describe particles with several mass and spin states and to give a satisfactory account of the transition between two such mass states, a problem which is otherwise quite intractable. The relationship of spin and statistics is discussed and it is concluded that, apart from the special cases of spin 0, $\frac{1}{2}$, 1, there is no necessary connection between spin and statistics. A.

530.145 : 530.12

2336. Non-linear field theories. BERGMANN, P. G. *Phys. Rev.*, **75,** 680–5 (*Feb.* 15, 1949).—The first paper in a programme concerned with the quantization of field theories which are covariant with respect to general coordinate transformations, like the general theory of relativity. All these theories share the property that the existence and form of the equations of motion is a direct consequence of the covariant character of the equations. It is hoped that in the quantization of theories of this type some of the divergences which are ordinarily encountered in quantum field theories can be avoided. The present paper lays the classical foundation for this programme: it examines the formal properties of covariant field equations, derives the form of the conservation laws, the form of the equations of motion, and the properties of the canonical momentum components which can be introduced. A.

530.145 : 532.7

Uncertainty relations and quantum fluids. *See Abstr.* 2370

530.145 : 537.122

2337. On the self-energy of a bound electron. KROLL, N. M. AND LAMB, W. E., JR. *Phys. Rev.*, **75,** 388–98 (*Feb.* 1, 1949).—The electromagnetic shift of the energy levels of a bound electron has been calculated on the basis of the usual formulation of relativistic quantum electrodynamics and positron theory. The theory gives a finite result of 1 052 Mc/s for the shift $2^2S_{\frac{1}{2}} - 2^2P_{\frac{1}{2}}$ in H, in close agreement with the non-relativistic calculation by Bethe. A.

530.145 : 538.3 : 535.14

2338. The radiation theories of Tomonaga, Schwinger and Feynman. DYSON, F. J. *Phys. Rev.*, **75,** 486–502 (*Feb.* 1, 1949).—A unified development of the subject of quantum electrodynamics is outlined, embodying the main features both of the Tomonaga–Schwinger and of the Feynman radiation theory. The theory is carried to a point further than that reached by these authors, in the discussion of higher order radiative reactions and vacuum polarization phenomena. However, the theory of these higher order processes is a programme rather than a definitive theory, since no general proof of the convergence of these effects is attempted. The chief results obtained are (*a*) a demonstration of the equivalence of the Feynman and Schwinger theories, and (*b*) a considerable simplification of the procedure involved in applying the Schwinger theory to particular problems, the simplification being the greater the more complicated the problem. A.

530.145 : 539.13

2339. A note on the one-electron states of diatomic molecules. ERIKSON, H. A. AND HILL, E. L. *Phys. Rev.*, **75,** 29–31 (*Jan.* 1, 1949).—The explicit formulation of an integral of the motion is given for a single electron moving in the field of two fixed nuclei, for both the classical and the quantum mechanical cases. The corresponding quantal operator together with the Schrödinger Hamiltonian and the operator for the component of the orbital angular momentum of the electron about the internuclear axis form a complete set of commuting observables of the problem. This supplies the dynamical interpretation of the separation parameter of the energy equation. A.

530.145 : 539.172

2340. On the transmutation of elementary particles. PROCA, A. *C.R. Acad. Sci., Paris*, **228,** 298–300 (*Jan.* 24, 1949) *In French.*—In order to develop a theory where the particles are stationary states of a single system, relativistic equations are derived in which the spin is described by 4 variables and their conjugate momenta. G. J. K.

530.145 : 539.185 : 537.13

2341. The magnetic moments of the neutron and proton. CASE, K. M. Letter in *Phys. Rev.*, **74,** 1884–5 (*Dec.* 15, 1948).—The new invariant many-time formalism for electromagnetic fields is applied to calculate these moments through the interaction of a pseudoscalar meson field with nucleons treated relativistically. The results for charged and symmetric theories are finite. To give the neutron moment the interaction constant is $g^2/4\pi\hbar c \sim 0{\cdot}2$. The ratio $R = (1 - \mu_p - \mu_n)/(\mu_p - \mu_n - 1)$ is 0·5 for the charged theory, 0·2 for the symmetric theory using a meson mass $\mu = M/10$, compared with the experimental value $R = 0{\cdot}03$. With other types of meson or coupling a correct value for R may be obtained. G. J. K.

GENERAL MECHANICS . MECHANICS OF SOLIDS 531

531.19 : 535.43

Scattering of light by an almost ideal Bose–Einstein gas. *See Abstr.* 2455

531.224 : 539.434

2342. Bending of beams with creep. POPOV, E. P. *J. Appl. Phys.*, **20**, 251–6 (*March*, 1949).—A method of calculating stresses and deflections for beams whose material creeps is presented. A.

531.35 : 521.1 : 523.2 : 629.19

The dynamics of space-flight. *See Abstr.* 2277

531.383

2343. A magnetic gyroscope. ARRIGHI, G. *Mem. Accad. Naz. Lincei.* (*Mem. Cl. Sci. Fis. Mat. Nat.*) **1**, 195–204 (1947) *In Italian.*—Theory of a hypothetical model. The gyroscope consists of a symmetrical rigid body with a fixed point on the axis of symmetry and subjected to forces due to two dipoles disposed thus: one is fixed in the body along the axis of symmetry, the other is fixed in space in line with the fixed point of the body. The potential function due to these dipoles is expanded in a series of Legendre polynomials, and the precession of the body is discussed. When the poles of the spatially fixed dipole are very distant from the fixed point compared with the poles of the other dipole, the motion is like that of an ordinary gyroscope under the action of gravity. M. R.

531.55

2344. The mathematical theory of the motion of rotated and unrotated rockets. RANKINE, R. A. *Philos. Trans. A.*, **241**, 457–585 (*March*, 1949).—A study of the mathematical theory of rocket motion. The aerodynamic forces and couples, and those due to the action of the burning gases, are investigated as fully as possible, and the equations of motion are set up in their most general form. The effects of disturbing forces, such as wind and asymmetry of design or functioning, are considered. Solutions of the equations, most of which are suitable for numerical computation, are given under various assumptions regarding axial spin, aerodynamic lift, acceleration, etc. An investigation of the conditions for stable motion is carried out. The paper concludes with a summary in which the main features of rocket motion, as revealed by the theory, are discussed in general terms. A.

531.552 : 551.510.535 : 523.5

Ballistics of the upper atmosphere. *See Abstr.* 2832

531.555 : 531.112.8

2345. Aerodynamic pursuit curves for overhead attacks. HANDELMAN, G. H. *J. Franklin Inst*, **247**, 205–22 (*March*, 1949).—The basic assumptions for the problem are discussed in some detail and the corresponding differential equations set up. These have been integrated graphically and the results are considered at length. Short discussions of the method of obtaining the basic constants in the problem and the graphical technique employed in integrating the basic equations are given. A.

MECHANICAL MEASUREMENTS 531.7

531.715.2 : 535.8.085.392

2346. A multiple-reflection optical lever. HOADLEY, H. O. *Rev. Sci. Instrum.*, **20**, 30–41 (*Jan.*, 1949).—A detailed description is given of an optical lever which secures increased sensitivity by means of multiple reflections from a single small mirror. It is of particular use where space is limited, or where the mirror must have minimum size and mass. Its limitations are an inherent restriction of the measurable range, and a comparatively rapid loss of light with increasing number of reflections. A model system was constructed, which demonstrates that no special difficulty is met with in making an optical lever according to these principles up to 7 reflections. Tests made with the fifth-order reflection proved the model to be quite satisfactory. A.

531.724

2347. A determination of the texture of iron powders of large coercive force by the measurement of their heat of wetting. WEIL, L. *C.R. Acad. Sci., Paris*, **227**, 48–50 (*July* 5, 1948) *In French.*—By comparing the heat of wetting of Fe powders produced by reduction of formiates with that of carbonyl Fe of known particle size, the effective surface area of the Fe powder is estimated. A. E. DE B.

531.74

2348. Measuring instruments—the division on glass of graduated arcs of instruments. DELHOMME, F. AND MARTIN, J. *C.R. Acad. Sci., Paris*, **227**, 335–7 (*Aug.* 2, 1948) *In French.*—The technique of making scales on glass by depositing by evaporation a thin homogeneous layer of Pb or Al, ruling with a dividing engine, and coating with a protecting layer of varnish is fully described. S. W.

531.78

2349. A simple method of measuring small forces. MICHELL, D. *J. Sci. Instrum. Phys. Ind.*, **26**, 141–2 (*April*, 1949).—A convenient means of measuring a small unknown force consists of applying the force to a milliammeter coil and adjusting the current in the coil until an exact balance is obtained. Fluctuating forces may similarly be measured by an electrical device which provides an automatic adjustment of the current, and simultaneously operates a recording instrument. A.

531.787

2350. A self-contained recording pressure gauge. BROWN, D. R., GALLOWAY, W. C., ROBERTSON, J. B. AND SILVEY, G. A. *Rev. Sci. Instrum.*, **20**, 27–9 (*Jan.*, 1949).—This instrument is a self-contained time/pressure recording device capable of measuring pressures up to 1 200 lb/in² at frequencies from 0 to 200 c/s over a period of 5 sec. The instrument is set in operation by the arrival of a pressure wave above a predetermined threshold, triggering a locking mechanism and permitting compressed springs to drive the record surface past an engraving stylus actuated by a pressure-sensitive diaphragm. A.

531.787

2351. A recording mechanical pressure gauge of high range. HIGGS, P. M. *Rev. Sci. Instrum.*, **20**, 23–6 (*Jan.*, 1949).—An instrument of rugged con-

struction for recording very large and rapidly fluctuating pressures in liquids and gases is described. The pressure-sensitive element is a thick, flat, circular diaphragm, rigidly mounted and fluid damped. The pressure/time record is engraved upon the surface of a rotating polished metal disc by a stylus fastened directly to the diaphragm. The record may be read with a precision of better than 1% of full deflection. The instrument will record pressures up to 1 000 lb/in² at frequencies from zero to 500 c/s. A.

531.791 : 537.542 : 539.16.08

A Geiger–Mueller counting circuit. *See Abstr.* 2564

MECHANICS OF FLUIDS 532

532.133 : 541.182.6 : 532.77

2352. Theory of viscosity of suspensions and solutions. Effect of small particle size. VAND, V. *Čas. Pěst. Mat. Fys.*, **73** (*No.* 4) 141–6 (1949) *In English.*—Theory of viscosity of suspensions is extended to cover molecular particle size range by introducing a correction factor containing the ratio of the volumes of the solvent to the solute molecules. Viscosity formulae are given, in which interactions, collisions and hydration are taken into account, and which can be applied to solutions. A.

532.137

2353. On the determination of corrections in measurements of viscosity. LEDERER, E. L. *Schweiz. Arch. angew. Wiss. Tech.*, **14**, 372–7 (*Dec.*, 1948) *In German.*—An expression is derived which gives the correction to viscosity measurements when the temp. of the liquid differs by a known amount from any of four standard temp. (0, 20, 50, 100°c). Tables are supplemented by a nomogram rendering any reference to the standard temp. unnecessary. R. A. W.

532.137 : 532.517

Viscous flow round plane obstacles. *See Abstr.* 2356

532.511 : 551.51

2354. A systematic treatment of moving axes in hydrodynamics. MCVITTIE, G. C. *Proc. Roy. Soc. A*, **196**, 285–300 (*March*, 1949).—A method is developed for transforming the equations of hydrodynamics to a system of curvilinear co-ordinates in motion relative to fixed axes using the tensor-calculus and without employing Coriolis's theorem. The basic entity is the kinetic metric, a four-dimensional quadratic form defined through the kinetic energy of unit mass of fluid. The mechanics of special relativity are used to obtain, by approximation in terms of $1/c^2$, where c is the velocity of light, the classical formulae. The equations of motion in terms of the energy-tensor, the four-dimensional vorticity-tensor and the velocity-components are successively obtained and the equation of continuity is shown to be independent (in mathematical form) of the motion of the co-ordinate system. This property holds also for the equation of heat-transfer in a non-viscous fluid. Applications are made to the case of local Cartesian and local cylindrical polar co-ordinates on the earth's surface. Formulae for the rate of change of vorticity due to Helmholtz and to Petterssen, respectively, are obtained as special cases and Sawyer's theory of tropical cyclones is also discussed. A.

532.511 : 551.51

2355. Two-dimensional fluid motion referred to a network of orthogonal curves. MCVITTIE, G. C. *Proc. Roy. Soc. A*, **196**, 301–10 (*March*, 1949).—A theory already developed [Abstr. 2354 (1949)] is applied to the case of two-dimensional motion parallel at each point of space to some member, Σ, of a one-parameter family of surfaces, the co-ordinate system being a network of orthogonal curves drawn on Σ. The geodesic curvatures of the orthogonal curves and their relationship to the Gaussian curvature of Σ are worked out. The equations of motion and of continuity are expressed in terms of the geodesic curvatures. Meyer's aerodynamical equations are derived as particular cases when the network is fixed in space and the surfaces are all planes. A formula for a large-scale gradient wind is also obtained as an example of the use of a moving network drawn on a sphere. A.

532.517 : 532.137

2356. The flow of viscous fluids round plane obstacles. ROSCOE, R. *Phil. Mag.*, **40**, 338–51 (*March*, 1949).—In certain cases of slow flow round thin plates the solution of the Stokes equations can be reduced to a solution of Laplace's equation, the flow being thus related to an electrostatic potential distribution. It is shown that (1) the force on a plate perp. to a stream of velocity U is $8\pi\mu CU$, where μ is the viscosity of the fluid and C the electrical capacity of a conductor of the same shape as the plate, (2) the rate of flow of fluid through an elliptic aperture in a thin wall is $2S^2/3\pi\mu s$ times the pressure difference between the two sides, S being the area of the aperture and s its perimeter. A simple expression is derived for the torque on an elliptic plate rotating about its minor axis. Approx. methods for dealing with the flow past plates of complicated shapes are described, and the case of a paddle-type viscometer is treated as an example. A.

532.517.4 : 532.7

2357. The mathematical bases of Heisenberg's theory of turbulence. BASS, J. *C.R. Acad. Sci., Paris*, **220**, 228–9 (*Jan.* 17, 1949) *In French.*—Heisenberg's new theory of turbulence [see Abstr. 469 (1949)], derived by developing the velocity components of the motion in terms of ordinary Fourier series or integrals, is considered to be unsatisfactory, and the author develops a rigorous formalism which retains the basic ideas of the theory. J. S. G. T.

532.517.4 : 533.6.013.3

Steady turbulent flow in a compressible fluid. *See Abstr.* 2379

532.52

2358. Note on a general form for the equation of flow of a liquid with a free surface. JAEGER, C. *C.R. Acad. Sci., Paris*, **223**, 417–19 (*Sept.* 9, 1946) *In French.*—The generalized Bernoulli equation is written down and transformed into the form $F(x, y, z, h) = 0$. This is interpreted as defining a surface in space of 4 dimensions. There exist points on this surface such that $\partial x/\partial h = \partial y/\partial h = \partial z/\partial h = 0$, and the value, h_0, of h at such a point is important in the theory. L. S. G.

532.528 : 537.221 : 534.321.9

2359. On the magnitude of the electric field in cavities formed by ultrasonic cavitation in a liquid. NATANSON, G. L. *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 1) 83–5 (1948) *In Russian.*—Y. I. Frenkel (*J. Phys. Chem., USSR*, **14**, 305 (1940)] calculated the electric field on the surface of a cavity in a liquid. The calculation was based on asymmetry in the instantaneous distribution of ions about the surface of rupture. Into Frenkel's result there enters a parameter representing the thickness of the surface of rupture, which is taken to be of the order of the intermolecular distance. Here the same basic physical picture is treated by a different method obviating the necessity for assuming the rupture-thickness. The electric field E in a cavity is found to be $E = 4\pi\varepsilon\sqrt{N/S}\chi$ where ε is the charge on a univalent ion, N the number of dissociated molecules per unit vol., S the cross-section of the cavity, and χ the Debye inverse radius for the ionic atmosphere. In deriving the above formula edge-effects were neglected, so it is only applicable when $\sqrt{S} \gg \chi^{-1}$. A. SCH.

532.54

2360. Flow through a pipe with a porous wall. OLSON, F. C. W. *J. Appl. Mech.*, **16**, 53–4 (*March*, 1949).—The problem of the flow through a long unbranched pipe with uniformly spaced orifices presents some undesirable mathematical difficulties. These can be avoided by solving the related problem of the flow through a pipe with a porous wall. The differential equations for the pressure drop and flow are derived and the relation between them is indicated. A solution for the flow is obtained in terms of elliptic functions in such form that numerical results can be obtained readily from existing tables. A.

532.542

2361. On the Poiseuille flow. YADOFF, O. *C.R. Acad. Sci., Paris*, **223**, 192–3 (*July* 22, 1946) *In French.*—The velocity distribution is found explicitly for the case of flow in a horizontal pipe of rectangular or triangular cross-section. The formulae are derived from appropriate solutions of Poisson's equation. L. S. G.

532.57

2362. The Hydrodynamics Laboratory of the California Institute of Technology. KNAPP, R. T., LEVY, J., O'NEILL, J. P. AND BROWN, F. B. *Trans. Amer. Soc. Mech. Engrs*, **70**, 437–57 (*July*, 1948).—A description of the laboratory and the principal pieces of equipment that have been developed during the last five years. The field of investigations undertaken is presented in general terms. A.

532.57

2363. A liquid metering system for small rates of flow. HILL, S. *J. Sci. Instrum. Phys. Ind.*, **26**, 138–9 (*April*, 1949).—A description of a liquid metering system consisting of a gear pump driven intermittently by an electric motor which is controlled by an electronic timing circuit. At each half cycle of the timing circuit the motor is switched on, performs a fixed number of revolutions, and is switched off. Thus the average speed of the pump over a long time depends only on the constancy of the timing circuit, which is affected only slightly by mains voltage fluctuations. The system, which was designed to control the rates of flow of sugar liquors through laboratory scale-adsorption columns, is constant to about 0·2% over a 30 to 1 range. A rubber tube and capillary tube "smoothing network" is used to convert the pulsating flow through the pump to uniform flow through the apparatus. A.

532.582.81

2364. Movement of gas bubbles at high Reynolds numbers. LEVITCH, V. G. *J. Exp. Theor. Phys., USSR*, **19**, 18–24 (*Jan.*, 1949) *In Russian.*—The theory of the boundary layer at the separation liquid-gas is considered and the result applied to the computation of the resisting forces acting on a gas bubble rising in the liquid; this force is found to be proportional to the velocity for $R \gg 1$. It is shown that the character of the stream-lines of a bubble materially differs from that of the flow around a solid sphere. The theory is in satisfactory agreement with the experimental data. B. F. K.

532.59 : 532.13

2365. Wave flow of thin layers of a viscous fluid. III. Experimental study of wave flow conditions. KAPITSA, P. L. AND KAPITSA, S. P. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 2) 105–20 (1949) *In Russian.*—A method of taking photographic skiagrams of a lamina of a viscous fluid with a view to studying the free flow on the outer wall of a cylindrical tube. The necessary conditions for the existence of a 2-dimensional wave-flow of a lamina were found. Quantitative determinations of the amplitudes, phase velocities and wavelengths were carried out for a number of flow types of water and alcohol. A series of photographs of sections of flow laminae are given. The results are compared with the theory worked out in the foregoing part of the paper. Experimentally it could be shown that the wave flow due to a certain critical efflux is more stable than the laminar one. The magnitude of the critical efflux, as found by experiment for water and alcohol, is in good agreement with theory. Two distinct types of undular flow were established; the first, in close agreement with theory, with a wave shape nearing a sinusoid, was called periodic regime, whilst the second is a new type, consisting of single waves moving independently of each other. The empirically found dependence for the periodic regime of amplitudes, phase velocity and wavelength on the efflux again corresponds to the theoretical predictions within the limits of accuracy of the approximations made. B. F. K.

532.61

2366. Consideration of the Gibbs theory of surface tension. TOLMAN, R. C. *J. Chem. Phys.*, **16**, 758–74 (*Aug.*, 1948).—The Gibbs theory is discussed, the structure of transition layers between phases being treated in detail. This provides theoretical information as to the magnitude of surface tension and the location of the surface of tension, which can be used in making applications of the Gibbs theory. A.

532.61 : 534.22

Surface tension and the velocity of sound. *See Abstr.* 2389

532.612.3 : 539.42

2367. Surface tension of solids and methods of measuring the same. ANTONOFF, G. *J. Phys. Coll. Chem.*, **52**, 969–75 (*June*, 1948).—The surface tension T of a solid can be measured with a fluid whose surface tension $\simeq$ that of the solid, and is variable by adding a third substance. The breaking stress method gives good agreement with capillary methods in the case of oils, and is used with thick pastes to determine T for glass. When the paste begins to wet the solid the two surface tensions are equal. T for glass = 130 dynes/cm. Theoretical support is given for the experimental method; frictional and viscosity effects can be disregarded. R. A. W.

532.62

2368. General theory of the formation of liquid films. ROBINSON, L. B. *J. Chem. Phys.*, **16**, 734–6 (*July*, 1948).—Langmuir's theory of liquid film formation in narrow capillaries is developed for the general case of any electrolyte. The determination of the thicknesses of such films involves hyperelliptic integrals. By suitable transformations the integrand may be represented as the product of binomial series and Legendre's series. No attempt is made to evaluate the thicknesses of the film numerically, because of the complexity of the necessary computations. A.

532.64

2369. Contact angles. CASSIE, A. B. D. *Disc. Faraday Soc.* (*No.* 3) 11–16 (1948).—The relationship of contact angles to surface structure is outlined. The difference between the advancing and receding angles is discussed in terms of the modern theory of multimolecular adsorption; this indicates that the advancing angle will be unique, whilst the receding one will generally be $<$ the advancing angle and need not have a unique value. A.

532.64 : 539.61

Adhesion and contact-angle at liquid-solid interfaces. *See Abstr.* 2764

MOLECULAR THEORY OF LIQUIDS 532.7

532.7 : 530.145

2370. Uncertainty relations and quantum fluids. MASSIGNON, M. D. *C.R. Acad. Sci., Paris*, **228**, 62–4 (*Jan.* 6, 1949) *In French.*—In the quantum theory of a liquid, operators can be defined for the hydrostatic pressure p_1 and the "thermodynamic" pressure p which are not identical owing to the non-commutability of the kinetic energy with the interaction potentials and their virial. The pressure p_1 is the first term in the expansion of p in powers of (h/kT). In a gas the difference $(p_1 - p)$ is negligible. Similar expansions for other static properties demonstrate the correspondence with classical statistical mechanics. G. J. K.

532.7 : 532.517.4

Heisenberg's theory of turbulence. *See Abstr.* 2357

532.72 : 535.417

2371. The Gouy diffusiometer; further calibration. OGSTON, A. G. *Proc. Roy. Soc. A*, **196**, 272–85 (*March*, 1949).—The application of the modified ray theory given by Kegeles and Gosting [Abstr. 303 (1948)] to the Gouy diffusiometer [Abstr. 850 (1948)] has been tested. It has been shown that experimental results, both with single homogeneous substances and with mixtures, agree well with its predictions. A simple method for analysing the diffusion data given by a mixture of two diffusing substances has been worked out and has been applied to the correction of the apparent diffusion constant of lactoglobulin contaminated by some heterogeneous material and to known mixtures of lactoglobulin with sucrose and potassium chloride. The necessary computations have been performed over a useful range of the variables and the results tabulated. Certain improvements in the experimental technique are described. A.

532.74

2372. The use of a model for studying the distribution of free volume in a liquid. RADCHENKO, I. AND SHESTAKOVSKI, F. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 2) 121–5 (1949) *In Russian.*—The distribution in a liquid of the existing micro-cavities according to the number of particles hemming them in was investigated by experiments with steel balls as models. The experiments were conducted under the following conditions: absence of forces of interaction; attracting forces; repelling forces; and forces of a dipole-character. B. F. K.

532.74 : 534.21

Sound absorption and structure of liquids. *See Abstr.* 2382

532.74 : 534.321.9 : 539.132

Absorption of ultrasonic waves in liquids. *See Abstr.* 2400

MECHANICS OF GASES 533

533.15

2373. Effusion of gases at critical velocities. BENSON, S. W. AND COSWELL, R. *J. Phys. Coll. Chem.*, **52**, 1332–44 (*Nov.*, 1948).—It is shown that when the ratio forward/back pressure for a gas effusing through an orifice exceeds 2, a region of critical flow velocity is reached. Q is then directly $\propto M^{\frac{1}{2}}Pf(\gamma)$, $f(\gamma)$ varying very little for most gases. A microeffusiometer is described having a small Pt orifice and equipped with automatic electric timers. This instrument can be used in most cases to measure molecular weights to within 4%. It is expected that the use of a thinner orifice would improve the absolute accuracy and extend the range through the elimination of viscosity effects. The apparatus has the advantages of using small gas samples (1–2 cm³ at S.T.P. minimum) and preserving the sample for further work. It should also be capable in its present form of measuring the relative densities of isotopic gases to within 0·2%, since in these cases the effects of viscosity may be expected to cancel. A.

533.15 : 523.877

Solution of the transport equation for the cylindrical case. *See Abstr.* 2320

533.15 : 539.155.2

Countercurrent gaseous exchange for isotope separation. *See Abstr.* 2662

533.24

2374. A large helium liquefier. DAUNT, J. G. AND JOHNSTON, H. L. *Rev. Sci. Instrum.*, **20**, 122–5 (*Feb.*, 1949).—A large He liquefier is described which produces 7·5 litres of liquid He per hour through a Joule–Thomson expansion valve when operated from a compressor giving 21 cu. ft/min flow at a pressure head of 320 lb/in². The liquid He can readily be transferred into exterior cryostats. The consumption of liquid H, used to pre-cool the He gas, during the process of liquefaction is 1·3 litres of H per litre He. The liquefier fits into a container 6 ft long by 8 in. in diameter. A.

535.5 : 621.327.4.032.11

2375. Role of vacuum technique in the luminescent tube industry. GOMONET, E. *Vide*, **3**, 487–95 (*July–Sept.*, 1948) *In French.*—Reviews history of discharge phenomena. Gas pressures for optimum power consumption, luminous intensity, open and closed circuit voltage in glow discharge tubes are shown graphically. Life of tubes, effects of different and mixed gases, fluorescent tubes and gettering are discussed. G. W. (R)

533.6.01

2376. An accurate gas metering system for laminar flow studies. ANDERSEN, J. W. AND FRIEDMAN, R. *Rev. Sci. Instrum.*, **20**, 61–5 (*Jan.*, 1949).—The design and performance of an accurate flow system utilizing critical velocity orifices is described. Results indicate that an absolute accuracy of 3 parts in 1 000 is realized over a flow range of 0·002–2 ft³/min. Calibration of the flow system was accomplished by means of a specially modified wet test gas meter. Descriptions of the flow system and of subsidiary calibrating equipment are presented. Critical flow orifice discharge coefficients are found to be independent of the type of gas; however, because of gas impurities, prediction of relative rates of flow of various gases through an orifice by use of theoretical relationships is uncertain, and experimental data are given to illustrate this. A.

533.6.011 : 533.7

2377. Some exact solutions of the gas-dynamic equations for central symmetric motion. STANYUKOVICH, K. P. *Dokl. Akad. Nauk, SSSR*, **60** (*No. 7*) 1141–4 (1948) *In Russian.*—The treatment allows for changes of entropy. After some obvious transformations the system proves to be easily solvable, furnishing solutions of a new class of "self-similar" motions of the gas which are important for astrophysical problems. Self-similar movements are defined as movements the distribution of whose parameters over r varies as the parameters themselves vary in time. The solutions are shown to be identical with self-similar movements already obtained in special cases by other methods. Among the examples treated is the case of the reflection of plane shock waves of variable entropy, moving at a constant velocity. B. F. K.

533.6.011 : 536.24

Heat transfer for laminar flow over inclined flat plates. *See Abstr.* 2463

533.6.011.3

2378. The decay of isotropic turbulence. FRENKIEL, F. N. *J. Appl. Mech.*, **15**, 311–21 (*Dec.*, 1948).—The equation of decay of isotropic turbulence is determined in the two cases of large and small Reynolds number of turbulence by using the von Kármán–Howarth equations and applying Loitsianskii's theorem of the conservation of the disturbance moment. The theoretical curves are compared with the results of measurements behind grids. The decay of longitudinal turbulent energy agrees with the theoretical equations for large Reynolds number of turbulence. The theory does not give the variation of the transverse scale of turbulence, but only the "disturbance length," which is a function of the longitudinal correlation. Thus the comparison for the scale is only qualitative. It is not possible to show agreement with the theoretical variation of the scale deduced from the equations. The difference is explained by the imperfect isotropy, which has a much greater influence on the variation of the scale than it has on the energy decay. A.

533.6.013.3 : 532.517.4

2379. On the two-dimensional steady turbulent flow of a compressible fluid far behind a solid symmetrical body. I (Momentum transfer theory). KRZYWOBLOCKI, M. Z. *J. Franklin Inst.*, **247**, 33–61 (*Jan.*, 1949).—The method of solution employed is an extension of that used by Schlichting [*Ingen. Arch.*, **1**, 533–71 (1930)] to solve the corresponding problem of flow of an incompressible fluid. The ultimate aim of the investigation is to solve the complete system of equations governing turbulent flow by the aid of momentum transfer theory and also by the aid of vorticity transfer theory, in order to determine whether the velocity distributions by both theories are the same. In this paper the momentum transfer theory is employed subject to certain restrictions—stresses due to viscosity, and molecular conductivity terms, being neglected. Expressions are obtained to represent temperature, pressure and longitudinal velocity components. G. G.

MOLECULAR THEORY OF GASES 533.7

VIBRATIONS . ACOUSTICS 534

534.1

2380. The Laplace transform solution of beams. THOMSON, W. T. *J. Acoust. Soc. Amer.*, **21**, 34–40 (*Jan.*, 1949).—The application of the Laplace transform to the general problem of the beam is discussed. The method requires no knowledge of normal modes often employed in the classical solution. A solution in closed form is given for the forced vibration of a hinged beam excited by a concentrated harmonic force. The result converges to the correct static curve for zero frequency. The method is extended to the problem of finding the natural frequencies of beams with concentrated mass and spring. The analysis for beams with several masses and springs is outlined. A.

534.1 : 517.933

2381. Topological aspect of forced oscillations. CARTWRIGHT, M. L. *Research, Lond.*, **1**, 601–6 (*Oct.*, 1948).—Equations of the form $\ddot{x} + f(x)\dot{x} + g(x) = p(t)$, govern relaxation oscillations and occur in electrical problems where Fe is contained in the magnetic circuit, and in acoustical problems connected with loudspeakers. They also occur in various types of radio circuits. The engineer wants to know what steady states are possible and the frequencies. A discussion is given of the possible types of solutions and their interrelationship. The methods are topological and involve some specialized mathematical ideas, but the methods are new and powerful. A bibliography of related literature (mostly American and Russian) is given. L. S. G.

534.21 : 532.74

2382. Sound absorption and structure of liquids. KNESER, H. O. *Naturwiss.*, **35** (*No.* 3) 88–92 (1948) *In German.*—A description of 3 methods of measuring absorption of h.f. sound in liquids. In the first method a continuous vibration from the transmitter is suddenly stopped and a record made showing the decay of sound received at known distances. In the second method a short sound impulse is transmitted and after travelling a measured distance in the liquid is reflected back to its source which also functions as a receiver. In the third method separate transmitter and receiver are used and the amplitude and phase recorded on a c.r.o. Frequencies of the order 10^7 c/s are used. The author considers the problem on the basis of relaxation times—pointing out that the relaxation time in liquids is $\sim 1\,000$ times shorter than in gases. The experimental results are indicated in a series of curves (abs. coeff. *v.* frequency) for benzol, water and ethylacetate. The bearing of these results on the structure of the liquids is discussed. A. B. W.

534.21 : 534.321.9

2383. Visual methods for studying ultrasonic phenomena. BARNES, R. B. AND BURTON, C. J. *J. Appl. Phys.*, **20**, 286–94 (*March*, 1949).—After a brief review of various applications of ultrasonic techniques, considerable attention is paid to the established methods employed for making sound waves visible. It is shown that these methods are primarily modifications of the technique of "schlieren photography" originally developed by Foucault and used frequently for photographing phenomena (e.g. air flow analysis) in which refractive index gradients are set up. The advantages and disadvantages of the various techniques are discussed in some detail and it is shown that a technique employed by Willard is particularly well adapted to the visualization of ultrasonic waves. A modification of this method is discussed, the experimental apparatus is described and typical photographs of ultrasonic wave patterns are shown. In particular, the close analogy existing between light waves and ultrasonic waves with respect to the wave phenomena of refraction, diffraction, and interference is demonstrated in a number of photographs. A.

534.21 : 535.61–31

2384. Sound absorption in air under ultra-violet irradiation. KRUDRYAVTSEV, B. B. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 2) 155–7 (1949) *In Russian.*—Comparative measurements by acoustic interferometer of sound absorption in ordinary air and in air under u.v. irradiation are described. In all, 104 ratios of absorption coeffs. for the 2 cases were established. The statistical evaluation of the results leads to the conclusion that the coeff. for irradiated air is somewhat $<$ for radiation-free air. B. F. K.

534.21

2385. One method of solution of boundary problems for the case of sinusoidal vibrations of an elastic cylinder. VEKVA, I. N. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 5) 779–82 (*May*, 1948) *In Russian.*—An equation is derived analogous to the known equation of the components of displacement in a single chain for the static case and is applicable to solution of boundary problems with known displacements or forces, leading in both cases to an equivalent integral equation for an arbitrary frequency. L. J. G.

534.213 : 534.321.9 : 539.2

2386. Absorption of ultrasonic oscillation by solid bodies. SOKOLOV, S. YA. *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 5) 883–6 (1948) *In Russian.*—Experimental investigation carried out on various metals, quartz and NaCl monocrystals, etc. The qualitative results obtained show that the absorption in homogeneous substances is small, and determined by the coefficient of viscosity and thermal surface-conductivity of the medium. The absorption of u.s. is found to increase considerably in elastically inhomogeneous media, particularly in metals of various structures. The absorption remains smaller in fine-grained metals than in coarse-grained ones, which may be explained by temp. fluctuations developing at the grain boundaries. These result in increasing the entropy, i.e. in thermal losses. Empirical relations were found and are exemplified on the test curves obtained for metals and monocrystals. B. F. K.

534.22

2387. On the velocity of sound in certain mixtures of hydrocarbons. UTTER, N. AND KLING, R. *C.R. Acad. Sci., Paris*, **227**, 41–3 (*July* 5, 1948) *In French.*—Rao has proposed the relation $a^{\frac{1}{3}}V = R$ for the velocity of sound a in a liquid of molar volume V; R is an additive function of the composition of the liquid. Thus in a mixture of 2 constituents the constant of the mixture $R_{12} = xR_1 + (1 - x)R_2$, x being the molar fraction of one of the constituents. Measurements have been made of the velocity of sounds in 2 series of mixtures of organic liquids, using the supersonic diffraction method of Lucas and Biquard—with an error < 1 part in 1 000. In the first series mixtures of hexadecane and normal heptane were used and in the second series, mixtures of butylbenzene and 2·2-dimethylbutane. A. B. W.

534.22

2388. Measurements on the velocity of sound in some organic liquids at low temperatures. VAN ITTERBEEK, A. AND DE ROCK, A. *Physica, 's Grav.*, **14**, 609–16 (*Jan.*, 1949) *In English.*—Experimental data are given on the velocity of sound in CCl_4, CS_2, benzene, ethyl-ether and toluene at various temps between their melting and boiling points. The observations were made at a frequency of 535 kc/s, and wavelength measurements obtained

with an accuracy ~0·1%. Combining the measured velocities with known values of the density of the liquids, the adiabatic compressibilities are calculated. Similar measurements are in progress to determine the velocity of sound in liquefied O, N, H and He.

A. B. W.

534.22 : 532.61

2389. Surface tension and velocity of sound. AUERBACH, R. *Experientia*, **4** (*No.* 12) 473–4 (1948) *In German.*—The empirical relation $\sigma = 6{\cdot}3 \times 10^{-4}\rho v^{3/2}$ dyne-cm connecting the surface tension σ of a liquid with its density ρ, and the velocity v with which it transmits sound, applies to many organic and inorganic liquids, including He at −272°c. Water is excepted. For solids $\sigma = 6{\cdot}3 \times 10^{-7}\rho^{1}\,{}^{4}E^{3/4}$ dyne-cm, E being Young's modulus. Crystals and gases are mentioned. Tables showing values for σ are given for solids and liquids.

R. A. W.

534.22 : 534.321.9

2390. Ultrasonic investigation of molecular properties of liquids. III. Linear polymethylsiloxanes. WEISSLER, A. *J. Amer. Chem. Soc.*, **71**, 93–5 (*Jan.*, 1949).—The variation of sound velocity with m.w. has been studied in a series of 14 polydimethylsiloxanes, at 30 and 50·7°. These fluids were found to possess remarkably high compressibilities. Bond increments for the molar sound velocity have been determined for the silicon–carbon and silicon–oxygen bonds. A.

534.22 : 534.321.9 : 538.65

2391. A suspected effect of a magnetic field on the velocity of ultrasonic waves (in fluids). SCHAAFFS, W. *Ann. Phys., Lpz.* (*Folge* 6) **2** (*Nos* 3–4) 158–60 (1948) *In German.*—According to the theory of Rama Rao, the velocity of sound in paramagnetic fluids should change when a strong magnetic field is applied. In nitrobenzene, the change should be 3–4%. Measurements in concentrated solutions of various Fe salts and in nitrobenzene in magnetic fields up to 10 400 gauss showed that no change was observed, although a variation of 0·25% could have been detected with certainty. It is therefore concluded that there are discrepancies in Rama Rao's theory.

H. J. H. S.

534.22 : 536.48

Properties of second sound. *See Abstr.* 2473

534.22 : 536.48

Velocity of second sound from 1·3 to 1·03°K. *See Abstr.* 2474

534.22 : 536.48 : 536.791.2

Excitation and propagation of second sound. *See Abstr.* 2475

534.22 : 541.6

2392. Propagation of ultrasonic sound in solutions. KRUDRYAVTSEV, B. B. AND SOROKINA, E. I. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 2) 158–63 (1949) *In Russian.*—Sound velocities were measured in various solutions by acoustic interferometer at different temps. Simultaneously, the densities of the solutions were determined. The molar sound velocities in the solutions were then calculated and were found not to vary with temp. Within the limits of experimental error these velocities represent additive functions of state of the mixtures, and also of the bonds in the molecules. Deviations from this law are probably explained by the formation of polar compounds which are broken up as the temp. rises. A method of approx. determination of molecular weights of dissolved substances was founded on the experimental results.

B. F. K.

534.22.094.1 : 541.182.4

2393. Propagation of sound in emulsions. ISAKOVICH, M. A. *J. Exp. Theor. Phys., USSR*, **18**, 907–12 (*Oct.*, 1948) *In Russian.*—It is shown that "thermal" dispersion of the velocities of sound and sound absorption must occur, with a characteristic dependence of the coeff. of absorption on frequency. A.

534.222.2

2394. On the existence of shock waves of rarefaction. NOVIKOV, I. I. *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 9) 1545–6 (1948) *In Russian.*—Shock-waves of rarefaction cannot occur when the adiabatic compressibility $(\partial V/\partial p)_s$ increases with increasing pressure. In certain special cases $(\partial^2 V/\partial p^2)_s$ is negative and shock-waves of rarefaction can in principle exist. An example, given by Zeldovich [*J. Exp. Theor. Phys.* (*No.* 4) 363 (1946)] is a van der Waals gas with a large specific heat at constant volume. Another example, wet steam in the neighbourhood of the critical pressure (approx. 210–225 atm.), is noted in the present paper.

A. SCH.

534.23

2395. Passage of finite amplitude pressure waves through temperature discontinuities. AUGENSTEIN, B. W. Letter in *Phys. Rev.*, **75**, 521–2 (*Feb.* 1, 1949).—A theoretical discussion having for its objects: (*a*) to derive the transmission properties of isentropic pressure waves of large amplitude through temperature discontinuities between two gaseous masses; (*b*) to "linearize" the results for very small amplitude waves, and thereby show that the usual equations of acoustic theory result. The results of the investigation have been extended, using graphical methods, to the cases of (*a*) ratio of specific heats γ different on the two sides of the interface, and (*b*) shock waves (non-isentropic state changes through the pressure waves) incident on the interface both with constant γ and varying γ. Within prescribed limits the isentropic wave theory gives results differing by only a few % from the values obtained by the use of exact shock-wave theory.

A. B. W.

534.232 : 537.228.1

2396. Low loss crystal systems. FRY, W. J. *J. Acoust. Soc. Amer.*, **21**, 29–33 (*Jan.*, 1949).—Some aspects of the theory of low loss piezoelectric vibrating systems are presented. The effect of small losses on the resonant frequency, the difference between the resonant and anti-resonance frequencies, and the electrical impedances at resonance and at anti-resonance, are calculated. A quality factor is defined and related to the mechanical loads on the crystal.

A.

534.24

2397. On the total reflection of plane impulse waves. FISCHER, F. A. *Ann. Phys., Lpz.* (*Folge* 6) **2** (*Nos* 3–4) 211–24 (1948) *In German.*—Solutions are given for partial and total reflection at a plane boundary between two media. By integrating this solution with

respect to frequency, the effect of a plane unit impulse represented by Dirac's δ-function, incident upon the separating boundary at any angle, is obtained. From numerical values for a boundary separating air and H graphs are given to illustrate the nature of the results obtained. G. G.

534.26

2398. Diffraction of a plane elastic wave relatively to a semi-infinite rigidly fixed slot. FRIEDMANN, M. M. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 7) 1145–8 (1948) *In Russian.*—The problem considered is 2-dimensional, and the wave assumed to be a non-stationary plane, longitudinal or transverse, elastic wave travelling along the straight slot. The solution is obtained by the method of functionally-invariant solutions of the wave equation, developed by Smirnov and Sobolev, and by the use of results of Muskhelishvili's theory of singular integral equations. The functions entering the real and imaginary parts of the solutions are either holomorphic in the complex plane, or holomorphic by segments. In the latter case the functions are found as solutions of 2 inhomogeneous Hilbert problems. It is shown that the existing discontinuities can be removed. B. F. K.

534.3

2399. Automatic musical accompaniment to vocal music. MODAK, H. V. *J. Univ. Bombay*, **16**, 24–31 (*March*, 1948).—A principle applicable to Indian music where the note-pitch of the accompanying instruments is the same as that sung. Proposed methods are: (1) a microphone and amplifier drives an exciting magnet placed over parallel wires tuned to different frequencies. The resulting note is impure, as several wires vibrate and the output is low; (2) the wires pass through a permanent field and carry the a.f. current. This gives a purer note; (3) a form of moving-iron loudspeaker movement is attached to a group of radiating wires. This method is stated to give the best results. H. G. M. S.

534.321.9 : 532.528 : 537.221

The electric field produced by ultrasonic cavitation in liquids. *See Abstr.* 2359

534.321.9 : 532.74 : 539.132

2400. Absorption of ultrasonic waves in liquids and its relation to molecular constitution. PINKERTON, J. M. M. *Proc. Phys. Soc., Lond. B*, **62**, 129–41 (*Feb.*, 1949).—Accurate measurements by the pulse method of the absorption of ultrasonic waves in H_2O and C_2H_5OH are described. In H_2O, the absorption coefficient varied as frequency^2 over the range 7·5 to 67·5 Mc/s and also decreased by a factor of 8 over the temp. range 0–95°c. The coefficient was about 3 times that deduced from Stokes' formula. In C_2H_5OH, measurements were made at 52·4 Mc/s; the variation with temp. over the range −50 to +60°c was about twice that given by the formula. Published values of the absorption coefficients of a wide range of pure liquids and mixtures are quoted and a classification is proposed. The mechanism of the absorption in associated liquids appears to be different to that in non-associated liquids. A simple theory based on relaxation phenomena is given to explain the observed variation of the absorption with concentration in mixtures of non-associated liquids. H. J. H. S.

534.321.9 : 541.182.6

Action of ultrasonic waves on suspensions. *See Abstr.* 2786

534.4

2401. Objectives for sound portrayal. POTTER, R. K. *J. Acoust. Soc. Amer.*, **21**, 1–5 (*Jan.*, 1949).—Translation of sound into visible patterns is discussed and the principles of the "sound spectrograph" described. It is suggested that no single design can be optimum and that perhaps the most useful standard of reference is the human ear. A.

534.44 : 534.78 : 621.395.625

2402. A playback for visible speech. SCHOTT, L. O. *Bell Lab. Rec.*, **26**, 333–9 (*Aug.*, 1948).—A simplified and greatly enlarged spectrogram is made by copying the pattern of a visible speech record by cutting out parts of an opaque sheet which is then played back through a 12-spectrum-channel vocoder. A separate pattern is provided to define pitch and voicing. The complete equipment may be valuable for speech study. P. O.

534.6 : 534.25

2403. The double crystal acoustic interferometer. FRY, W. J. *J. Acoust. Soc. Amer.*, **21**, 17–28 (*Jan.*, 1949).—A one-dimensional theory of operation of the double crystal acoustic interferometer is presented. The theory is sufficiently general to include both resonance and off resonance operation and acoustic loading of the crystals. The effects of holder losses and electrical loading of the receiver crystal are also included. A relation is developed which can be used to obtain values of the acoustic velocity and absorption coefficient of the coupling medium from the experimental measurements. A.

534.61 : 621.317.789

2404. Development, design and construction of equipment for electro-acoustics research. BHATT, N. B. *Electrotechnics*, **20**, 40–6 (*March*, 1948).—Describes the development, design and construction of a sound level meter (s.l.m.) and a reverberation time meter. For calibrating the former a standard sound source was not available and a subjective method using a Western Electric audiometer was devised. The method consisted of placing an observer to face a loudspeaker and fixing to his left ear a receiver excited by the audiometer. The latter also energizes the loudspeaker via an attenuator and amplifier. The observer keeps the level in the receiver constant and adjusts the attenuator till the level from the loudspeaker as heard by his right ear is the same. The observer's head is then replaced by a microphone connected to the s.l.m. and output meter. Calibration is determined from the attenuator settings when the audiometer output reading = that of the s.l.m. The application of this meter to the measurement of the transmission loss of a heavy door is described. The method of using the s.l.m. together with a time interval meter for measuring reverberation time is also described. B. B. A.

534.612

2405. The use of sound level meters. *Brit. Stand.* 1479 (1948).—The type of objective instrument known as the "sound level meter" is coming increasingly into use for the practical measurement of sound or noise.

The object of this memorandum is to draw the attention of users to a number of important aspects of the design and operation and to precautions in the interpretation of the reading they give.

534.62 : 621.317.39

2406. Reverber-o-graph (an electronic reverberation recorder). BHATT, N. B. AND SUBRAHMANYAM, D. L. *Electrotechnics*, **20**, 47–54 (*March*, 1948).—Describes an instrument for recording the decay of sound energy density in rooms in db on the screen of a long persistence c.r.o. An intensity range of $\sim 10^6$ is compressed by a logarithmic stage and applied to the vertical plates of the oscillograph. A linear time base is used. Provision is made for sweep times of 1, 2, 3, 5 and 7 sec, these values being chosen to accommodate reverberation times of rooms ranging in size from a small studio to a large auditorium. A.

534.64

2407. Methods of measurement in acoustics. BRÜEL, P. V. *Trans. Chalmers Univ. Tech., Gothenberg*, **63**, 5–21 (1947) *In Swedish.*—The principal terms used in experimental acoustics are carefully defined. Following each definition, the method (or methods) of measurement of the quantity referred to is described, and precautions to be observed in measurement are stated. Among the subjects considered are: sound spectrograms, noise level, reverberation time, absorption coefficient, air-borne sound insulation, impact sound insulation. G. G.

534.852 : 538.12 : 681.84 : 621.395.625.3

2408. Magnetic field distribution of a ring recording head. BEGUN, S. J. *Audio Engng*, **32**, 11–13, 39 (*Dec.*, 1948).—A graphical analysis is made of the magnetic field to which successive layers of the recording medium parallel to the pole surface are subjected. It is shown that at the centre of the gap the longitudinal components of the induction for layers close to the pole faces are almost four times greater than for the deepest layers, also that the effect of the perpendicular component is much more pronounced in layers adjacent to the pole face. Experience has shown that a.c. biasing of the field must be of a certain magnitude to assure a linear transfer characteristic and the analysis indicates that underbiasing is less harmful than overbiasing. The variation of magnetization in nearby and distant layers of the recording medium and its effect at higher frequencies are discussed. No account is taken of the effect of change of direction of the magnetizing force or of demagnetizing effects. B. B. A. (R)

OPTICS . RADIATION . SPECTRA 535

535.1 : 530.12

The ether-drift and the Lorentz transformations. *See Abstr.* 2328

535.14 : 530.14

Relativistic covariance in the theory of super-quantized photons. *See Abstr.* 2330

535.14 : 538.3 : 530.145

Radiation theories of Tomonaga, Schwinger and Feynman. *See Abstr.* 2338

535.14 : 612.84

Light quanta and vision. *See Abstr.* 2843

535.231.4.08 : 536.33 : 621.385.1.032.216

2409. The optical pyrometry of oxide cathodes and the measurement of spectral emissivity. CHAMPEIX, R. *Vide*, **3**, 469–79 (*July–Sept.*, 1948) *In French.*—Several methods of measuring the true temperature of oxide cathodes are discussed, including the method recently described by the author [Abstr. 599 (1948)] which depends on the very accurate measurement of power input to a filamentary cathode. The best method is the use of the reflectometer described by Prescott and Morrison [Abstr. 881 (1939)]. Results on both sprayed and cataphoretically coated cathodes are given as a function of coating thickness. The emissivity decreases as the thickness increases, values for sprayed cathodes are 0·21 at 45 μ thickness, 0·07 at 85 μ and for cataphoretic coatings 0·26 at 40 μ, 0·13 at 80 μ. Activation introduces no specific change. A. H. W. B. (R)

535.243

2410. A method of semi-quantitative spectrography. RONGE, H. *Tidskr. Ljuskultur*, **20**, 26–8 (*Jan.–March*, 1948) *In Swedish.*—The importance of a suitable "radiation climate" in illumination is discussed. A photographic method of determining the relative energy distribution over the various wavelengths in a given radiation is explained. The method is based on the assumption that the law of reciprocity is valid, with sufficient approx., in heterochromatic photography, and uses a low (2 mm) spectrograph slit and a plate which is moved vertically during exposure. Thus the lower portion of the plate is exposed longer than the upper, the latter registering only the more intensive radiation, the lower part picking up the less intensive wavelengths. The apparatus is described and records are shown. J. A. W.

535.317 : 522.21

2411. New wide-aperture cata-dioptric systems. WYNNE, C. G. *Mon. Not. Roy. Astr. Soc.*, **107** (*No.* 4) 356–68 (1947). Shortened version in *Rev. Opt.* (*Théor. Instrum.*) **27**, 185–91 (*March*, 1948) *In English.*—The higher orders of spherical aberration and residual oblique aberrations are examined in the Maksutov lens. Systems employing 2 menisci are described, giving good axial correction up to $f/0{\cdot}7$ and little oblique aberration (other than field curvature) for a 30° field. Large glass thicknesses may be avoided by division of the menisci into 2 thin lenses, and the residual high-order spherical aberration terms may be balanced. The influence of glass inhomogeneity is discussed. A. HU.

535.317.5 : 535.421

Third order aberrations of the diffraction grating. *See Abstr.* 2454

535.32 : 548.7 : 537.226

Application of the Lorentz–Lorenz equation to crystals. *See Abstr.* 1444

535.33

2412. The absorption spectrum of dense lithium vapor. CH'EH, S.-Y. AND CHANG, C.-S. *Phys. Rev.*,

75, 81–3 (*Jan.* 1, 1949).—35 new lines or diffuse bands appeared in the neighbourhood of the principal series lines of Li absorption spectrum were measured. The temperature of the absorption tube was 850–1 040°c. He, Ne, and A were used to lessen the speed of distillation of Li to the cooler part of the tube. The appearance and the position of these lines or bands are not influenced by the nature of the foreign gas employed. A.

535.33

2413. Isotope shifts in uranium spectra. BURKHART, L. E., STUKENBROEKER, G. AND ADAMS, S. *Phys. Rev.*, **75**, 83–5 (*Jan.* 1, 1949).—A study is made of the isotopic shift of U^{238}, U^{235} and U^{233} in the emission spectrum of U. The shift is sufficient to allow quantitative determination of the concentration of the components of a mixture of the U isotopes by routine spectrographic analysis. Data show comparative values obtained by mass spectrometer and spectrograph. A.

535.33 : 535.34 : 535.6 : 541.6

2414. Relationships between absorption spectra and chemical constitution of organic molecules. FERGUSON, L. N. *Chem. Rev.*, **43**, 385–446 (*Dec.*, 1948.)—A brief historical account of theories concerning the origin of colour in organic compounds is given. Correlations between the wavelength of absorption bands and the chemical constitution of organic molecules are reviewed and present-day quasi "classical quantum-mechanical" concepts on colour are discussed. The influence on colour of such factors as resonance, steric hindrance, the conjugation and insulation of chromophores, and linearly conjugated chromophores is illustrated. The effects of stereostructural changes on the position and the number of absorption bands are described. Several quantitative relationships between the wavelength of the maximum absorption band and chemical constitution are presented. (312 references.) A.

535.33 : 537.228.5 : 539.132

The Stark effect for a rigid asymmetric rotor. *See Abstr.* 2638

535.33 : 539.13

Electronic states of organic molecules. *See Abstr.* 2633

535.331

2415. Term values in complex spectra (Columbium I and II) RAO, V. R. *Indian J. Phys.* **22**, 429–36 (*Oct.*, 1948).—Term values for d^4 and d^3s configurations of Cb II have been calculated from Ostrofsky's and Bowman's formulae and compared with experimental data of Meggers and Humphreys. New formulae are calculated for the d^4s configuration of Cb I and the term values are found to agree fairly well with observed data; the positions of unidentified terms are also predicted. A. G. G.

535.331 : 538.615

2416. Note on the theory of the quadratic Zeeman effect in the caesium spectrum. BROER, L. J. F. *Physica, 's Grav.*, **14**, 623–8 (*Jan.*, 1949) *In English.*—A wave-mechanical treatment of the quadratic Zeeman effect in the absorption spectrum of Cs, similar to that by Schiff and Snyder for Na and K, enables the structure to be calculated. Results are given for principal quantum number $n = 30$ and 35. Two satellite components observed by Harting and Klinkenberg are attributed to spin-orbit coupling. A. G. G.

535.332 : 537.52

Ion lines in the positive gas discharge column. *See Abstr.* 2523

535.332 : 538.615 : 539.153.4

2417. Zeeman effect and *g*-values for neutral nitrogen and oxygen. KIESS, C. C. AND SHORTLEY, G. *Science*, **107**, 649–50 (*June* 18, 1948).—Red and infrared lines, $3p\ ^4D^0$, $3p\ ^4P^0$ and $3p\ ^4S^0$ to $3s\ ^4P$ of N I, and $3p\ ^5P$, $3p\ ^3P$ to $3s\ ^5S^0$, $3s\ ^3S^0$ of O I have been studied at fields of 35 000 and 85 000 gauss. Anomalies in intensity and displacement—observed particularly for O I—arise from the fact that the splitting in the field is of the same order as the no-field separation of the levels. The *g*-values derived conform to those required for *LS*-coupling although the intervals—except those of $3p\ ^4D^0$ of N I—do not follow Landé's rule. R. F. B.

535.333 : 536.52 : 536.462

Measurements of flame temperatures by atomic spectral lines. *See Abstr.* 2478

535.333 : 537.52

Emission spectrum of chlorine during Joshi-effect. *See Abstr.* 2524

535.333 : 539.13

2418. The microwave spectrum of carbonyl selenide. STRANDBERG, M. W. P., WENTINK, T., JR. AND HILL, A. G. *Phys. Rev.*, **75**, 827–32 (*March* 1, 1949).—The microwave absorption spectrum of carbonyl selenide, OCSe, is reported. The expected linear structure is confirmed. The spectrum includes absorptions caused by various isotopic forms of the molecule in the zero-point vibrational state and the first excited symmetrical stretching and bending vibrational states. From these data vibration-rotation interaction coefficients, mass differences and approximate interatomic distances have been determined. Values for the nuclear spins of the 6 stable selenium isotopes are suggested. Observations of the Stark effect lead to a determination of the dipole moment of the molecule in several vibrational states. Intensity measurements are used to determine vibrational frequencies and relative isotopic abundance. A.

535.333 : 551.594.5

Nitrogen bands in the upper atmosphere. *See Abstr.* 2839

535.333–15 : 523.87

2419. Red and infrared bands of titanium and zirconium oxides. KIESS, C. C. *Publ. Astr. Soc. Pacif.*, **60**, 252–3 (*Aug.*, 1948).—Tabulated wavelengths of band-heads are available at the National Bureau of Standards. R. F. B.

535.333–15 : 539.132

2420. A study of the high frequency fundamental bands in the spectrum of AsH_3 and AsD_3. MCCONAGHIE, V. M. AND NIELSEN, H. H. *Phys. Rev.*, **75**, 633–9 (*Feb.* 15, 1949).—An analysis has been carried out on the fundamental bands ν_1 and ν_2 (Dennison's notation), in the infrared spectrum of AsH_3. This analysis has made possible the evalua-

tion of the reciprocals of inertia, B, and the Coriolis coupling coefficient, ζ_2. These are found to be $B'' = 3{\cdot}723\ cm^{-1}$, $B'(\nu_1) = 3{\cdot}682\ cm^{-1}$, $B'(\nu_2) = 3{\cdot}69\ cm^{-1}$ and $\zeta_2 = -0{\cdot}0602$. The harmonic vibration frequencies have been computed after the method of Dennison. The values obtained are $\omega_1 = 2\,209{\cdot}2\ cm^{-1}$, $\omega_2 = 2\,225{\cdot}8\ cm^{-1}$, $\omega_3 = 973{\cdot}3\ cm^{-1}$, and $\omega_4 = 1\,012{\cdot}1\ cm^{-1}$ for the AsH_3 molecule and $\omega_1 = 1\,571{\cdot}2\ cm^{-1}$, $\omega_2 = 1\,582{\cdot}4\ cm^{-1}$, $\omega_3 = 696\ cm^{-1}$, and $\omega_4 = 718{\cdot}6\ cm^{-1}$ for AsD_3. This information permits the calculation of ζ_2 for AsD_3. A value $\zeta_2 = -0{\cdot}0383$ is obtained which is in satisfactory agreement with experimental data. For AsD_3 the following B values prevail; $B'' = 1{\cdot}896\ cm^{-1}$, $B'(\nu_1) = 1{\cdot}883\ cm^{-1}$, and $B'(\nu_2) = 1{\cdot}874\ cm^{-1}$. The B'' values obtained enable one to estimate closely that the value of r(As–H) is equal to 1·513 Å and the H–As–H angle is equal to 89° 50′. A.

535.333–15 : 539.132

2421. Infra-red bands in the spectrum of difluoromethane. Stewart, H. B. and Nielsen, H. H. *Phys. Rev.*, **75**, 640–50 (*Feb.* 15, 1949).—8 absorption bands have been observed in the i.r. spectrum of CH_2F_2. Seven of these are believed to be fundamental bands and have been identified as follows, the symmetry species of the band being given in parentheses: $\omega_1(A_1) = 2\,949\ cm^{-1}$, $\omega_2(A_1) = 1\,116\ cm^{-1}$, $\omega_4(A_1) = 528{\cdot}6\ cm^{-1}$, $\omega_6(B_1) = 3\,015{\cdot}2$, $\omega_7(B_1) = 1\,176{\cdot}1\ cm^{-1}$, $\omega_8(B_2) = 1\,089{\cdot}7\ cm^{-1}$ and $\omega_9(B_2) = 1\,435{\cdot}4\ cm^{-1}$. A band of species B_1 is observed at $2\,945\ cm^{-1}$. It is identified as $\omega_5 + \omega_9$ and from this it is inferred that $\omega_5(A_2) = 1\,510{\cdot}6\ cm^{-1}$. Rotational constants for the normal state are found to be $B'' = 0{\cdot}354\ cm^{-1}$ and $C'' - B'' = 1{\cdot}303\ cm^{-1}$. From these values the values $r_0(C - F) = 1{\cdot}32$ Å and $\angle(F - C - F) = 107°$ are obtained assuming that $r_0(C - H) = 1{\cdot}094$ Å and $\angle(H - C - H) = 110°$. A.

535.334 : 523.77

Forbidden Fe II lines in the solar spectrum. *See Abstr.* 2298

535.334 : 523.77

New solar lines in the region 1·52–1·75 μ. *See Abstr.* 2299

535.338.1

2422. On the origin of continuous spectra in the rare gases. Argon. Herman, L. and Weniger, C. *C.R. Acad. Sci., Paris*, **226**, 2134–6 (*June* 28, 1948) *In French.*—Describes measurements on the continuum ($\lambda \sim 2\,000$–$6\,000$ Å) emitted by A at 10 mm Hg press. The presence of H, contrary to certain previous conclusions, is not essential for the continuous emission. The possible mechanism of electron excitation of diatomic A_2 molecules is discussed. J. D. C.

535.338.332 : 539.153

2423. Fine structure of the hydrogen α-line. Kuhn, H. and Series, G. W. Letter in *Nature, Lond.*, **162**, 373 (*Sept.* 4, 1948).—Interferometric studies of the line as emitted in a deuterium discharge tube immersed in liquid H lead to the conclusion that the $2\,S_{\frac{1}{2}}$ level is displaced upwards by $0{\cdot}043 \pm 0{\cdot}006\ cm^{-1}$—in rather poor agreement with the results of earlier work [Abstr. 3606 (1947)] and of theoretical calculations [Abstr. 3608 (1947), 1890 (1948)]. Preliminary results about the position of the $3\,S_{\frac{1}{2}}$ level agree closely with the predictions of the Dirac theory but not with Bethe's theory. R. F. B.

535.338.334 : 523.774

Theoretical contours of absorption lines. *See Abstr.* 2301

535.34 : 535.61–31 : 541.8

2424. Does ultraviolet absorption intensity increase in solution? Jacobs, L. E. and Platt, J. R. *J. Chem. Phys.*, **16**, 1137–45 (*Dec.*, 1948).—Absolute absorption intensities and oscillator strengths were determined for isoprene and cis- and trans-piperylenes in the region 1 750–2 400 Å, in vapour and in *n*-heptane solution, using a vacuum fluorite spectrograph. For the 3 compounds the best values of the experimental Lorentz–Lorenz correction, or ratio of integrated intensities under the molar absorption curves for solution and vapour, were close to unity, a result obtained previously by Pickett and coworkers for cyclo-pentadiene and -hexadiene absorption. A value of $0{\cdot}98 \pm 0{\cdot}04$ for this correction represents the mean of all 5 of these determinations. Every determination was substantially below the correction factor of 1·30 predicted by Chako's classical oscillator theory for this wavelength region and these solvents. A.

535.341

2425. Determination of the potential energy curve for the excited state of gaseous HCl: comparison of theoretical and experimental extinction coefficients. Romand, J. and Vodar, B. *C.R. Acad. Sci., Paris*, **226**, 2062–4 (*June* 21, 1948) *In French.*

535.342 : 523.774

Fraunhofer lines in the solar spectrum. *See Abstr.* 2302

535.343 : 535.375.5 : 539.132

2426. The vibrational spectrum and thermodynamic functions of acrylonitrile. Halverson, F., Stamm, R. F. and Whalen, J. J. *J. Chem. Phys.*, **16**, 808–16 (*Aug.*, 1948).—The infrared spectra of gaseous and liquid acrylonitrile were studied from 2·5 μ to 25 μ with a spectrometer using LiF, CaF_2, NaCl, and KBr prisms. The Raman spectrum of the liquid was obtained, including intensity and polarization data. A normal co-ordinate calculation of the non-planar frequencies was made, using force constants from related molecules. This information permits a complete assignment of the 15 fundamental frequencies and a calculation of the thermodynamic quantities for the molecule. A.

535.343 : 539.132

2427. Vibrational frequency assignments for paraffin hydrocarbons; infra-red absorption spectra of the butanes and pentanes. Rasmussen, R. S. *J. Chem. Phys.*, **16**, 712–27 (*July*, 1948).—The i.r. absorption spectra from 2 to 15 μ are given for *n*-butane, isobutane, *n*-pentane, isopentane, and neopentane. Vibrational assignments for these molecules and for propane are deduced. The band positions correlatable with particular types of vibration of various hydrocarbon groupings are discussed. A.

535.343–15 : 539.133 : 541.5

2428. Vibration spectra of hydrocarbon molecules. I. Frequencies due to deformation vibrations of hydrogen atoms attached to a double bond. Sheppard, N. and Sutherland, G. B. B. M. *Proc. Roy. Soc. A*, **196**,

195–216 (*March* 22, 1949).—An analysis has been made of the infrared and Raman spectra of alkyl substituted ethylenes for "characteristic" frequencies in the region between 1 500 and 700 cm^{-1}. The mean values of the frequencies characterizing the various types of substitution are as follows: asymmetrically disubstituted, 1 415 and 890 cm^{-1}; trans-disubstituted, 1 303 and 973 cm^{-1}; cis-disubstituted, 1 260 and 973 cm^{-1}; mono-substituted, 1 415, 1 295, 990 and 910 cm^{-1}; trisubstituted, 1 383 and 820 cm^{-1}. These frequencies have all been assigned to specific modes of vibration, essentially localized in deformation motions of the H atoms directly attached to the double bond; the higher frequencies ($> 1\,000\ cm^{-1}$) are concerned with motions in the plane of the ethylenic double bond and the lower frequencies arise from motions out of that plane. Using a valency force field, a theoretical explanation has been given of the persistence of these characteristic frequencies in alkyl substituted ethylenes and detailed calculations have been made of the relevant force constants involved. The variation in certain of these characteristic frequencies when halogen atoms replace the alkyl groups has been considered and shown to be due to changes in the force constants and not to the changes in the masses of the substituents. For a given type of substitution, the force constant decreases progressively along the series alkyl group, I, Br, Cl and F, i.e. with increasing electronegativity. The use of these methods to provide a means of following changes in the electronic structure of the double bond with substitution is discussed. A.

535.343.31–15/23

2429. A study of the absorption spectrum of benzene. II. Interpretation of the spectrum of benzene in the liquid state between the visible and 3·5 μ. Causse and Barchewitz, P. *J. Phys. Radium*, **10**, 49–52 (*Feb.*, 1949) *In French.*

535.343.31–32

2430. Further alkylbenzene spectra to 1 750 A. Platt, J. R. and Klevens, H. B. *J. Chem. Phys.*, **16**, 832–4 (*Aug.*, 1948).—Earlier work [Platt and Klevens, *Chem. Rev.*, **41**, 301 (1947)] is continued. The absolute absorption intensities of *n*-butyl-, secondary butyl-, and tertiary butylbenzene and of 1,3,5-trimethylbenzene (mesitylene) were measured to about 1 750 Å. A.

535.343.32 : 539.132

2431. Theory of the optical absorption spectra in metal amide solutions. Davidov, A. S. *J. Exp. Theor. Phys., USSR*, **18**, 913–16 (*Oct.*, 1948) *In Russian.*—The theory given is based on the theory of the localized quantum states of the electron (polarons) in an inertially polarizing medium, developed by Pekar [Abstr. 1257, 1258 (1947)]. A.

535.343.32 : 541.14

2432. On the photo-chemistry of some ions in solution. Farkas, L. and Klein, F. S. *J. Chem. Phys.*, **16**, 886–93 (*Sept.*, 1948).—The absorption spectra of chlorate, bromate, iodate, and hypobromite ions and of hypobromous acid were measured. The decomposition of bromate ion was investigated in the light of a mercury arc in the spectral region: 1 900 Å to 2 600 Å. The quantum yield of the decomposition is 0·19. A.

535.343.32 : 541.182.6

2433. Infra-red Christiansen filter effect in slurries of organic crystals. Price, W. C. and Tetlow, K. S. *J. Chem. Phys.*, **16**, 1157–62 (*Dec.*, 1948).—The Christiansen filter effect in slurries of organic crystals is reported for the first time in the infrared. The main difference between the effect in molecular and ionic crystals is that the Christiansen (transmission) peak and the "Reststrahlen" (reflection) peaks are much closer together for organic crystals since they are produced by a single frequency instead of a wide band of lattice frequencies. The Christiansen effect is much more selective in organic crystals since it occurs for some bands but not for others. This is thought to be due to the nature of the coupling between the particular vibration and the atoms or groups in the molecule which make major contributions to the polarizability. A.

535.343.41

2434. The absorption spectrum of diborane. Price, W. C. *J. Chem. Phys.*, **16**, 895–902 (*Sept.*, 1948).—The absorption spectrum of diborane has been investigated in the infrared from 1 to 25 μ and in the vacuum ultraviolet down to 1 000 Å. The rotational structure obtained for certain of the infrared bands rules out the ethane-type structure but agrees very well with the interpretation of the electron diffraction results in terms of a bridge model. The ultraviolet spectrum indicates a simple electronic structure and a first ionization potential about 11–12 V. A.

535.343.4 : 523.77 : 551.510.4

Telluric CH_4 bands in the solar spectrum. *See Abstr.* 2300

535.343.4–14

2435. The radio-frequency spectroscopy of gases. Bleaney, B. *Rep. Phys. Soc. Progr. Phys.*, **11**, 178–204 (1946–47).—A review which describes the basic components of microwave apparatus required and the experimental methods used for spectroscopy, both with waveguides and cavity resonators. The theoretical and practical aspects of collision-broadening and the spectra of H_2O vapour, O_2, and NH_3 receive special attention. 70 references. D. H. W.

535.347 : 535.54 : 541.64

2436. Polarized infra-red radiation as an aid to the structural analysis of long-chain polymers. I. Elliott, A., Ambrose, E. J. and Temple, R. B. *J. Chem. Phys.*, **16**, 877–86 (*Sept.*, 1948).—An experimental procedure is described for measuring dichroism in the i.r. spectrum of oriented materials. Oriented films of polythene, polyvinyl alcohol, polyvinyl chloride, polyvinyl acetate, and Nylon have been examined in the region 3 600–700 cm^{-1}, and the species (parallel or perpendicular) of many bands has been identified. The bearing of these results on current ideas concerning the structure of these polymers is discussed. A general result is that frequencies involving the motion of H atoms show rather low dichroism. On the other hand, very high dichroism has been found in some frequencies in which the motion is believed to be confined to other atoms. A.

535.347 : 548.0

2437. Molecular theory of pleochroism [in crystals]. Davidov, A. S. *J. Exp. Theor. Phys., USSR.*, **19**

(*No.* 2) 168–74 (1949) *In Russian.*—A theory of pleochroism of molecular crystals is attempted. The energy states of the individual molecules are assumed to be known, and the changes of the energy spectrum owing to combinations of the molecules to form crystals of arbitrary symmetry are investigated. The possibility of the production of new "crystalline" absorption bands is shown, disappearing at a fusion of the crystal. Referring to the example of crystals containing 2 and 4 molecules in a single crystal cell it is shown that the frequency of the absorbed light will depend on the direction of the propagation and polarization, respectively. B. F. K.

535.361.2

2438. Surface reflectometer for evaluating polished surfaces. OLLARD, E. A. *J. Electrodepos. Tech. Soc.*, **24**, 1–8 (1949).—Light is incident normally on the surface under test, and the diffused light (but not the specularly reflected light) is collected on a selenium photocell; the photo-current is a measure of the diffuse reflection factor. The instrument gives a quantitative comparison of differently polished surfaces of the same material, places them in the same order as the Guild photometer, and is simpler in operation. N. C.

535.37

2439. Luminescence of silver halide salts. GOLUB, S. I. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 7) 1153–5 (1948) *In Russian.*—U.v. excitation of AgCl monocrystals at low temp. produces fairly intense blue fluorescence, whereas AgBr shows a much weaker yellow-greenish effect. Afterglow in pure AgCl crystals can only be detected by the phosphoroscope, it lasts 0·05 sec and is also blue. Admixture of Mn produces intense red afterglow of $\sim$0·05 sec duration, and a weak yellow phosphorescence of up to 1 min duration. No afterglow could be detected in pure AgBr crystals, not even with phosphoroscopes of $\simeq 10^{-3}$ sec resolving capacity. Fluorescence spectrograms and excitation spectra were measured photometrically. The results are reported and discussed and the spectral curves given. The extinction law is of the usual form $I = At^{-\alpha}$, where $\alpha = 0{\cdot}25$ (for AgCl). For the given reason (no afterglow detectable) an extinction law for AgBr could not be found. B. F. K.

535.37

2440. On the destruction of ZnS–Cu phosphors by grinding, and consequent emission effects. FREY, F. *Ann. Phys., Lpz.* (*Folge* 6) **2** (*Nos* 3–4) 147–57 (1948) *In German.*—The effects of grinding processes on a ZnS–Cu phosphor are studied, and the influence of grinding time and speed on final grain size distribution shown by curves. The average grain size after equal grinding times is not a simple function of the grinding speed but approaches a limit of $\sim 4\ \mu$ with continued grinding. X-ray photographs of the ground specimens are shown and intensity measurements plotted to show the transition between wurtzite and blende structure. Good agreement with the results on grain size is found. The emission intensity of the phosphor both during and after u.v. irradiation declines rapidly with increasing grinding time. Emission spectra under cathode ray excitation show a shift of the band maximum from 525 mμ to 565 mμ with progressive grinding. Also the blue band of the base material becomes prominent as the transition progresses, showing that the emission of the impurity centres is most susceptible to destruction by grinding. C. C.

535.371

2441. Analysis of the decay curves of powdered phosphors. ANTONOV-ROMANOVSKI, V. V. AND KRYLOVA, E. C. *J. Exp. Theor. Phys., USSR*, **19**, 63–73 (*Jan.*, 1949) *In Russian.*—It is shown that the luminosity of a weakly excited phosphor ZnS + Cu, referred to the elementary cell, falls on a second order hyperbolic curve. This is demonstrated as an invariant property of the shape of the extinction curve, becoming manifest when the luminescent process is of the simple bimolecular kind. B. F. K.

535.371.07

2442. The response of certain inorganic phosphors to far ultraviolet radiation. TOMBOULIAN, D. H. AND PELL, E. M. *J. Appl. Phys.*, **20**, 263–7 (*March*, 1949). —The response characteristics of a number of inorganic phosphors have been investigated in the extreme u.v. region ($\sim$170 Å) for the purpose of selecting a luminescent screen suitable for the measurement of relative intensities in conjunction with photo-multipliers. Preliminary tests indicate that in this spectral region luminescence is excited rather strongly in the tungstates. Sample screens of $CaWO_4$ have been studied photographically in order to determine to what extent such screens give rise to a faithful reproduction of the intensity distribution of the exciting radiation. Qualitative calculations show that the luminescent intensity excited by weak soft X-ray radiation is above the noise level of the conventional photo-multiplier. A.

535.375.5

2443. Apparatus for the study of the Raman effect at low temperatures. VODAR, B., JARDILLIER, Y. AND MAYENCE, J. *C.R. Acad. Sci., Paris*, **222**, 1493–5 (*June* 24, 1946) *In French.*—The apparatus and mode of use are described. It may be used at temperatures down to that of liquid nitrogen. L. S. G.

535.375.5

2444. Modifications caused in the Raman spectrum of a quartz crystal by compression along a binary axis. MARIÉE, M. AND MATHIEU, J. P. *C.R. Acad. Sci., Paris*, **223**, 147 (*July* 17, 1946) *In French.*—Compression along a binary axis of a quartz crystal should cause the 3-fold axes to disappear, and only 2-fold axes remain. As a result, it is to be expected that (1) 4 singlet vibrations antisymmetric to the binary axes should become Raman active, (2) each of the 8 degenerate vibrations should split into a symmetric and an antisymmetric vibration, both active. In the spectrum (1) should cause the appearance of 4 new weak lines, while (2) should cause a doubling of the degenerate frequencies. Also, the compression may be expected to raise the frequencies of some of the vibrations. The quartz crystal was squeezed hydralically with a pressure of 3·2 tonnes/cm^2. The scattering was observed along the direction of the 3-fold axis, with incident beam at right-angles. The degenerate frequency 128 cm^{-1} was clearly increased by 2 cm^{-1}. With less certainty, an increase in the frequency

264 cm^{-1} was seen. A new line was thought to be seen close to that at 204 cm^{-1}. A. C. M.

535.375.5

2445. Some characteristic frequencies in the Raman spectra of saturated aliphatic hydrocarbons. SHEPPARD, N. *J. Chem. Phys.*, **16**, 690–7 (*July*, 1948).

535.375.5 : 539.132

2446. Spectroscopic studies of rotational isomerism. I. Liquid *n*-butane and the assignment of the normal modes of vibration. SZASZ, G. J., SHEPPARD, N. AND RANK, D. H. *J. Chem. Phys.*, **16**, 704–11 (*July*, 1948).—The Raman spectrum of *n*-butane has been investigated over the temperature range 147°K to 305°K. The results clearly show the presence of two rotational isomers in the liquid. These are the planar, trans-form (symmetry C_{2h}) and probably the gauche form obtained by a rotation of 120° about the central C–C bond (symmetry C_2). The photoelectric spectrograph was used for quantitative intensity measurements on the line pair at 432 cm^{-1} and 325 cm^{-1} over the temperature range studied. These lines belong to the two rotational isomers and the results were used to give a value of 770 ± 90 cal. $mole^{-1}$ for the energy difference, $-\Delta H$, between the two forms of *n*-butane in the liquid phase. This result is shown to be in good agreement with a value assumed by Pitzer in his treatment of long chain paraffins. A detailed assignment has been made of the vibrational spectrum of the trans-rotational isomer. A.

535.375.5 : 539.132

2447. The Raman spectra at low temperatures—diphenyl sulphide, diphenyl methane and sulphur monochloride. MAJUMDAR, N. C. *J. Sci. Industr. Res.*, **8 B**, 25–9 (*Feb.*, 1949).—The spectra are measured for the liquids at 33°c and the solids at −170°c. The principal changes are the appearance of a new line at 46 cm^{-1} in solid diphenyl sulphide, and of 2 at 50 and 65 cm^{-1} in solid diphenyl methane, which may be due to rotational oscillations. For S_2Cl_2 there are 4 new lines in the solid, one of which at 692 cm^{-1} is attributed to the S = S stretching in $S=S<^{Cl}_{Cl}$ molecules. D. H. W.

535.375.5 : 539.155.2

2448. Fine structure of Raman lines due to chlorine isotopes. RANK, D. H., SHEPPARD, N. AND SZASZ, G. J. *J. Chem. Phys.*, **16**, 698–703 (*July*, 1948).—The isotopic fine structures of polarized lines in the Raman spectra of trichloroethylene, tetrachloroethylene, 1,2-dichloroethane, methyl chloroform, 1,1,2-trichloroethane, and 1,1,2,2-tetrachloroethane were studied. Observed and computed contours are compared. In most cases the results agree with theory. The fine structure pattern obtained for the "trans" form of 1,1,2,2-tetrachloroethane is anomalous. This anomaly is possibly caused by weak mechanical coupling between the motions of the two $-CCl_2$ groups in this molecule, or by the presence of a weak combination band that distorts the contour. Experimental methods of checking these explanations are discussed. A.

535.376 : 539.164

2449. Emission of ultra-violet radiation in gases traversed by α-particles. AUDUBERT, R. AND LORMEAU, S. *C.R. Acad. Sci., Paris*, **228**, 1318–20 (*Jan.* 24, 1949) *In French.*—The total intensity of the emission of u.v. radiation by O, N, Ne, and A during bombardment with α-particles, as measured with a photocell, is ∝ the square root of the pressure for the diatomic gases and to the pressure itself for the monatomic gases. The light-emission is not due to recombination of ions as the intensity is not altered by an intense electrostatic field, but can be attributed to de-activation of atoms activated by the α-particles. H does not fit into this scheme, unless the presence of H_3-molecules is assumed. C. B. A.

535.377 : 548.0 : 535

2450. Decay of the luminescence of coloured alkali-halide crystals. KATZ, M. L. *J. Exp. Theor. Phys., USSR*, **18**, 944–9 (*Oct.*, 1948) *In Russian.*—The shape of the extinction curves was found to vary with temp. An interpretation of this phenomenon is given by comparing the extinction curves with those for thermoluminescence. A.

535.39

2451. Optical properties of surface films. II. ROTHEN, A. AND HANSON, M. *Rev. Sci. Instrum.*, **20**, 66–72 (*Jan.*, 1949).—Measurements of ellipticity of light reflected from a film-coated metal surface have been made for films varying in thickness from 25 to 40 000 Å. It was found that the approximate formulae of Drude which express as a function of the film thickness the ratio and phase difference of the components vibrating in the plane of incidence and perpendicular to it are valid for thin films. The general formula of Drude expressing the phase shift as a function of the film thickness represents with a fair approximation the experimental results obtained with metallic slides coated with films of Ba stearate whose thickness ∼ the wavelength of light. Thus, for the first time, Drude's theoretical formulation has been verified experimentally. For films whose thickness is ⩾ the wavelength of the light used, there is a progressive divergence from Drude's general formula, possibly owing to the birefringence of the films which has been neglected in this work. A.

535.417 : 532.72

Interference diffusiometer. *See Abstr.* 2371

535.42

2452. On the modification of diffraction figures by means of intensity filters. LANSRAUX, G. *C.R. Acad. Sci., Paris*, **222**, 1434–5 (*June* 17, 1946) *In French.*—A new instrument for attenuating the diffraction rings in the image of a point source is briefly described. The relevant theory is outlined and the influence of spherical aberration is discussed. L. S. G.

535.42

2453. A new method for calculating non-uniform transparent diaphragms reducing the effects of diffraction. DUFFIEUX, P. M. *C.R. Acad. Sci., Paris*, **222**, 1482–4 (*June* 24, 1946) *In French.*—A Fourier-transform method is used and some special types of diaphragms are discussed. The general case may be treated by means of Hermite functions. L. S. G.

535.42 : 551.593.5/.7

Theory of diffraction of light in the atmosphere and hydrosphere. *See Abstr.* 2836

535.421 : 535.317.5

2454. Third-order aberrations of the diffraction grating. TORALDO DI FRANCIA, G. *Nuovo Cim.*, **6**, 24–9 (*Jan.*, 1949) *In Italian.*—A plane grating presents the same type of aberrations as a system of lenses and mirrors. Thus a combination of a plane grating and a spherical mirror may be used to eliminate third-order aberrations in the diffracted wave of a given order. L. P.

535.43 : 531.19

2455. Scattering of light by an almost ideal Bose–Einstein gas. GALANIN, A. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 2) 175–7 (1949) *In Russian.*—Optical diffraction in an almost ideal Bose–Einstein gas is treated on Bogolyubov's theory. The diffraction of visible light in such a gas > that in a classical gas by several orders of magnitude. B. F. K.

535.435 : 541.64 : 541.65

2456. The scattering of light and the radial distribution function of high polymer solutions. ZIMM, B. H. *J. Chem. Phys.*, **16**, 1093–9 (*Dec.*, 1948).—A radial distribution function of polymer segments in a solution of a high polymer may be defined as a quantity proportional to the density of segments at a given distance from some given segment. An approximate expression is derived for this function for dilute solutions of chain molecules of moderate degrees of polymerization. By Fourier inversion a simple expression for the intensity of light scattering, as a function of angle and concentration, may be obtained. A.

535.435 : 541.65/.69

2457. Apparatus and methods for measurement and interpretation of the angular variation of light scattering; preliminary results on polystyrene solutions. ZIMM, B. H. *J. Chem. Phys.*, **16**, 1099–116 (*Dec.*, 1948).—A photoelectric apparatus for the measurement of the angular dependence of light scattering from solutions is described in detail and its performance is discussed. Methods of calculation for the determination of the average extension of the scattering molecules from the data are described. Data are presented for two fractions of polystyrene in various solvents, showing the effect of changing solvent power and temperature, and also confirming a theoretically derived formula for the concentration dependence of the scattering. A.

535.436

2458. Composition of the radiation scattered by mercury vapour in the immediate neighbourhood of the optical resonance. LENNUIER, R. *C.R. Acad. Sci., Paris*, **223**, 145–6 (*July* 17, 1946) *In French.*—Radiation of wavelength 2 537 Å from an Hg lamp passes through a filter of Hg vapour into a tube T containing Hg vapour at a pressure of $1{\cdot}85\times10^{-4}$ mm. Atoms in T excited by the radiation remain in the level $^3P_1$ either for a relatively long period (mean life $1{\cdot}1\times10^{-7}$ sec), or for a short period which is a function of the difference between the incident frequencies ν and the proper frequencies ν_0 of the hyperfine levels of $^3P_1$. Emergent radiation from T is observed perpendicularly, and the radiation due to long stay is separated from that due to short stay, by applying a magnetic field along the direction of observation. Polarizations and intensities of radiation are investigated. A. C. M.

535.514.4

2459. Optical properties of polarizing filters made of polyvinyl alcohol. GODINA, D. A. *J. Tech. Phys., USSR*, **18**, 1317–24 (*Oct.*, 1948) *In Russian.*—The measurements were made in the range of 250–1 500 mμ by means of a quartz Beckmann spectrophotometer. Two kinds of filters produced by the experimenter were investigated, and compared with U.S.A.-produced filters. The polarizing filters give 100% polarization in the range from 250 to 800 mμ. The effect falls to zero in the interval 800 to 900 mμ and is absent up to 1 300 mμ. The filters transmit ~30% of the incident white light, there being practically no dissipation. In the visible part of the spectrum they may be taken to be neutral. B. F. K.

535.55 : 541.18

2460. The application of flow birefringence measurements to high-polymer solutions. WALES, M. *J. Phys. Coll. Chem.*, **52**, 976–83 (*June*, 1948).—A review of experimental flow birefringence data. The possibilities of using such data as a secondary method of molecular weight determination of high polymers, by analogy with the intrinsic viscosity, are considered. Two different average molecular weights are obtained, compared with one from intrinsic viscosity data. These are discussed. Reference is made to two quantities, previously discussed by W. and H. Kuhn [*Helv. Chim. Acta.*, **26**, 1394 (1943); **29**, 71 (1946)], which, if used to characterize colloidal materials, would eliminate questions of the correctness of the equations of Sadron and Mosimann [Abstr. 4745, 4746 (1938)]. The use as a test for polydispersity and as a standardized check of uniformity for process control is mentioned. H. G. J.

535.61–31 : 534.21

Sound absorption in air under u.v. irradiation. *See Abstr.* 2384

535.8

2461. Image shifts caused by rotating a constant-deviation prism in divergent light. SAUNDERS, J. B. *J. Res. Nat. Bur. Stand., Wash.*, **41**, 287–94 (*Oct.*, 1948).—Using constant-deviation prisms for producing monochromatic light introduces image shifts when changing spectral lines. The magnitudes of the lateral and the axial components of this shift, for a given rotation of the prism, depend upon the position of the axis of rotation. A position for the axis is known that yields zero lateral shift. The axial shift, however, also depends upon the convergence of the beam and the shape and optical properties of the prism. A method is presented for locating the positions of the axis of rotation for minimum axial and for minimum total shifts of the foci for both the sagittal and meridian fans of rays. A.

535.82

2462. Gibbs' phenomenon in phase-contrast microscopy. TORALDO DI FRANCIA, G. *Nuovo Cim.*, **6**, 30–8 (*Jan.*, 1949) *In Italian.*—Non-periodic objects are considered, of dimensions ⩾ the resolution distance. The effect of the phase plate is found to arise mathematically from Gibbs' phenomenon,

relating to the behaviour of Fourier series and integrals near a discontinuity of their sum. L. P.

535.89 : 771.44

Characteristics of photoflash lamps. *See Abstr.* 2849

HEAT 536

536.24 : 533.6.011

2463. Investigation of the variation of point unit heat-transfer coefficients for laminar flow over an inclined flat plate. DRAKE, R. M. *J. Appl. Mech.*, **16**, 1–8 (*March*, 1949).—Many applications of heat-transfer phenomena by forced convection require a knowledge of heat transfer from simple geometric bodies like the flat plate. Investigations of the flat plate have been limited, in general, to studies of isothermal plates of 0-deg. angle of incidence and in laminar flow. This paper provides information on the heat transfer from a non-isothermal inclined flat plate in laminar flow. It is shown that forced-convection heat-transfer data for an inclined non-isothermal flat plate with a constant specific rate of heat flow can be correlated and represented by an equation of the type $Nu_x/\sqrt{(Re_L)} = C(x/L)^n$ for laminar flow. It is further shown that this equation is similar in slope to the theoretical equation of the type $Nu_x/\sqrt{(Re_L)} = C_2(x/L)^{(m+1)/2}$ for an isothermal plate in laminar flow, but is larger by 30% in absolute value. This variance can be partly explained by an analysis of the behaviour of a non-isothermal plate as opposed to an isothermal one, but the full explanation is at present unknown. A.

536.25

2464. Dissipation of heat by free convection. ELENBAAS, W. *Philips Res. Rep.*, **3**, 338–60 (*Oct.*, 1948).—The differential equations governing the heat transfer by natural convection from a body at a temperature differing from that of its surroundings are derived. No general solutions can be found. For natural convection from two similar bodies it is shown that Reynolds' and Euler's numbers are of no importance, but if the Grashof (Gr) and Prandtl (Pr) numbers at corresponding points are respectively the same the velocity and temperature fields are similar, and thus the Nusselt (Nu) number is a function of Gr and Pr only. These considerations are applied to bodies characterized by one linear dimension (the flat vertical plate, horizontal cylinder and sphere), and the theoretical results, shown graphically, are compared with the experimental values. S. W.

536.33 : 535.231.4.08 : 621.385.1.032.216

Optical pyrometry of oxide cathodes and the measurement of spectral emissivity. *See Abstr.* 2409

536.4 : 539.893

Production of very high pressures by thermal means. *See Abstr.* 2766

536.4.032.2

2465. The freezing of supercooled water. DORSEY, N. E. *Trans. Amer. Phil. Soc.*, **38**, 247–328 (*Nov.*, 1948).—A detailed description is given of an experimental investigation of the supercooling and freezing of water. Many specimens of different types and origins were used, and the effects of age, preheating, prolonged chilling, thermal shock, distillation, filtration, solutes, mixing different specimens, and mechanical disturbance, were studied. The homogeneous and heterogeneous theories of freezing, based on the two types of singularities, are discussed, and the phenomena demanded by these theories listed. A singularity is a point at which freezing is spontaneously initiated in a supercooled melt, the homogeneous singularity being characterized solely by a local difference in the melt, and the heterogeneous by the presence of something foreign to the melt. The experimental observations are compared with the theoretical phenomena, and it is shown that the homogeneous theory is inapplicable, the heterogeneous too indefinite. A new explicit heterogeneous theory, which accounts qualitatively for the observed phenomena, is outlined and discussed. Incidental observations on the growth of ice spicules, the propagation of freezing along the wall of the container above the meniscus, the growth of ice by reverse sublimation and through the water, the adhesion of ice, and quiet boiling, are recorded. F. C. Brown's experiments [Abstr. 144 (1917)] on the bursting of hot-water pipes are discussed, and it is shown that while the experiments revealed the correct explanation of the phenomenon, they have been seriously misinterpreted. The correct explanation depends on the increased supercooling caused by the heating. S. W.

536.421 : 536.422/.423

2466. Melting and evaporation as rate processes. PENNER, S. S. *J. Phys. Coll. Chem.*, **52**, 949–54 (*June*, 1948).—Eyring's statistical theory of reaction rates [Abstr. 1206 (1935)] is applied to melting and evaporation. Making reasonable assumptions as to the nature of the activated complex formed during fusion and evaporation, expressions for the rates of fusion and evaporation are derived. It is shown that the Lennard-Jones [Abstr. 3001 (1940)] and Kincaid and Eyring [Abstr. 4330 (1938)] expressions for the free volume per molecule, for several solid elements, may be equated. The results for the rates of evaporation are of the same order of magnitude as those given by the Knudsen equation [Abstr. 1698 (1915)]. S. W.

536.421.4

2467. Purification, purity, and freezing points of 30 hydrocarbons of the API-standard and API-NBS series. STREIFF, A. J., ZIMMERMAN, J. C., SOULE, L. F., BUTT, M. T., SEDLAK, V. A., WILLINGHAM, C. B. AND ROSSINI, F. D. *J. Res. Nat. Bur. Stand., Wash.*, **41**, 323–37 (*Oct.*, 1948).—Describes the purification and determination of f.p.s and purity of 8 paraffins, 6 cycloparaffins, 3 aromatics, 12 olefins, and 1 acetylene. A.

536.422 : 536.423 : 542.4

2468. Molecular distillation and sublimation. CARMAN, P. C. *Trans. Faraday Soc.*, **44**, 529–36 (*Aug.*, 1948).—The general limitations of the process of molecular distillation as a chemical engineering unit operation, and its relationship to other modes of distillation, are discussed. It is pointed out that formation and transfer of vapour is achieved by three distinct mechanisms: (*a*) ebullition, (*b*) normal evaporative distillation, and (*c*) molecular distillation, in which the rate of distillation is controlled by the

rate at which the molecules escape from the free surface of the liquid. The relationship between the three is explained by considering a liquid maintained at a constant temperature while the pressure, P, in the space alone is gradually decreased. Sublimation of solids can be treated in exactly the same way as distillation of liquids. The transition from (*b*) to (*c*) is treated quantitatively and the fundamental equations defining the rates of evaporative distillation are derived. The case of water is considered in detail and the curves of w/w_0 against P for water for various temperatures between +20 and −80°C are shown (w = rate of distillation, w_0 = absolute rate of evaporation). The influence of the mean free path of the water vapour molecules in air is also discussed. S. W.

536.423.15 : 536.655

2469. The vapor pressure and heat of sublimation of graphite. Brewer, L., Gilles, P. W. and Jenkins, F. A. *J. Chem. Phys.*, **16**, 797–807 (*Aug.*, 1948).—The heat of sublimation of graphite and the heats of dissociation of CO and C_2 were established by the direct determination of the total vapour pressure of graphite by an equilibrium effusion method and by the determination of the partial pressure of C_2(gas) in equilibrium with graphite. The heat of sublimation of graphite to C(g) was found to be $\Delta H_0 = 170{\cdot}39 \pm 0{\cdot}20$ kilocalories per mole at 0°K. The heat of sublimation of graphite to C_2(g) was found to be $\Delta H_0 = 233{\cdot}1 \pm 7$ kilocalories per mole. The heats of dissociation of C_2 and CO were shown to be $4{\cdot}7 \pm 0{\cdot}3$ and $11{\cdot}109 \pm 0{\cdot}01$ eV, respectively. The accommodation coefficient of C gas on graphite at high temperatures is found to be about 0·3 and vaporized C gas is shown to be in the ^3P ground electronic state. A.

536.423.15 : 621.317.39 : 621.385.1

2470. An electrical method of measuring water vapour pressure in a sealed-off discharge tube. Clack, B. N. *J. Sci. Instrum. Phys. Ind.*, **26**, 58–9 (*Feb.*, 1949).—An electrical method of measuring water vapour pressure in small sealed-off valves is described in which the change in voltage drop across a glow discharge in the vapour is studied as the envelope is cooled. The method was developed primarily for measuring the partial pressure of water vapour in argon-water vapour mixtures in radar TR switches, but the application to other cases is discussed. Results are repeatable and are rapidly obtained. Vapour pressures of water of 0·5 mm and quantities of 0·1 μg can be estimated. A.

536.46 : 541.126 : 536.423

2471. Evaporation processes in a burning kerosine spray. Wolfhard, H. G. and Parker, W. G. *J. Inst. Petrol.*, **35**, 118–25 (*Feb.*, 1949).—A study for a fine spray burning in still air at room temp. A theoretical discussion of the heat available for evaporation has shown that in the conditions examined no significant evaporation of the droplets occurs before the preheating zone of the flame. This zone is very narrow, but there is sufficient time for the smallest droplets to vaporize and diffuse into the gases in this zone. Thus an inflammable mixture is formed which maintains the flame front. Some experimental evidence in support of this argument was obtained in photographs of kerosine droplets entering the preheating zone of a non-aerated Bunsen-type gas flame. A.

536.48

2472. Condensation of pure He^3 and its vapour pressures between 1·2° and its critical point. Sydoriak, S. G., Grilly, E. R. and Hammel, E. F. *Phys. Rev.*, **75**, 303–5 (*Jan.* 15, 1949).—20 cc S.P.T. of pure He^3 "grown" from H^3 were used. The pressure p was measured as a function of the amount q of He^3 condensed into a closed capillary, a constant portion of which was immersed in ordinary liquid He. The flats of the $p(q)$ curves at constant temperature give the vapour pressure and extrapolation to the critical point gives the critical temperature $3{\cdot}3_4$°K and pressure 875 mm Hg. A critical density of 0·041 g/cm³ is estimated by taking the mean of the values given by van der Waals' and Dietrici's equation of state. The boiling point is $3{\cdot}2_0$°K and the lowest vapour pressure measured is 23 mm Hg at $1{\cdot}21_1$°K. The density of the liquid cannot be measured accurately by the present arrangement, but a value of about twice the critical density is estimated near 2·8°K. H. L.

536.48 : 534.22

2473. Investigation of the properties of second sound. Peshkov, V. P. *J. Exp. Theor. Phys., USSR*, **18**, 867–72 (*Oct.*, 1948) *In Russian.*—The exceptionally high constancy of the second sound was experimentally established. An anomalous dependence of the amplitude of the oscillations on the power supplied was found when radiation was excited by the thermal method, whereas the observed dependence was linear when the method of filtration was used. The attenuation of the second sound in resonators was measured. A.

536.48 : 534.22

2474. Velocity of second sound from 1·3 to 1·03°K. Peshkov, V. P. Letter in *J. Exp. Theor. Phys., USSR*, **18**, 950–1 (*Oct.*, 1948) *In Russian.*—The experimental curve shows a minimum at 1·12°K with a subsequent steep rise at further lowering of the temp. This is in complete contradiction to Tisza's, and agreement with Landau's theory. As the main difference between the two authors' theories is to be found in the role ascribed to the phonon part of the thermal excitations, the conclusion to be drawn from the experiments is that the phonons combine with the rotons in producing second sound oscillations, and not with the super-fluidity component, as assumed by Tisza [Abstr. 252 (1948)]. A.

536.48 : 534.22 : 536.791.2

2475. Conditions of excitation and propagation of second sound. Peshkov, V. P. *J. Exp. Theor. Phys., USSR*, **18**, 857–66 (*Oct.*, 1948) *In Russian.*—The experimental data, combined with the laws of hydro- and thermodynamics, are used to derive the equations of propagation of ordinary and second sound in He II. The conditions of second sound radiation are studied by the thermal method and the filtration method, and the production of standing waves is considered. The thermal and viscous losses on the walls in the propagation process are estimated. A.

536.48 : 536.63

2476. Results of low-temperature research. V. Specific heat, heat of melting and evaporation as well as entropy of asymmetrical dideuterio ethylene $CH_2 = CD_2$. KRUIS, A. *Z. Naturforsch.*, **3a**, 596–602 (*Aug.–Nov.*, 1948) *In German.*—The specific heat C_p of $CH_2 = CD_2$ is measured between 15°K and the boiling point. It is higher than that of $CH_2 = CH_2$ all along the curve. The melting point is higher by 0·59°, the heat of melting higher by about 1 cal. An interpretation is given according to which a transition point near the melting point is shifted more than the m.p. itself. A difference between calorific and statistical entropy is found, which amounts to a zero point entropy of almost exactly $R\ln 2$. This value would be expected for a partially disordered lattice with two orientations of the molecule with the same statistical frequency. H. MO.

536.48 : 538.222

Paramagnetism of single crystals of salts of the Fe group at low temperatures. *See Abstr.* 2607

536.48 : 539.155.2

2477. On the He^3–He^4 equilibrium below the λ-point. LANE, C. T., FAIRBANK, H. A., ALDRICH, L. T. AND NIER, A. O. *Phys. Rev.*, **75**, 46–50 (*Jan.*, 1949).—Previous experiments attempting to establish the distribution of He^3 between the liquid and vapour phases of He^4, in the region below the λ-point, are discussed. It is pointed out that, because of the non-classical behaviour of liquid helium II, customary methods of analysis fail. New measurements, using an entirely different kind of technique, are reported, and the results compared with prior determinations. A.

536.48 : 539.374

Viscosity of metals at −253°C. *See Abstr.* 2760

536.52 : 536.462 : 535.333

2478. Measurement of flame temperatures by atomic spectral lines. SOBOLEV, N. N. *J. Exp. Theor. Phys., USSR*, **19**, 25–35 (*Jan.*, 1949) *In Russian.*—The possibility of measuring flame temperatures by the lines of atomic emission spectra, considering the influence of reabsorption, is investigated. It is found that Ornstein's method has only a limited range of application in the case of flames. An empirically developed method is suggested, according to which the line intensity in the central part of the spectrum is equal to the black-body intensity. B. F. K.

536.52 : 537.312.5

Lead sulphide photo-conductive cells for pyrometry. *See Abstr.* 2512

536.53 : 530.162 : 537.228.1 : 621.396.822

2479. Thermal voltages of a quartz crystal. COOK, R. K., GREENSPAN, M. AND WEISSLER, P. G. *Phys. Rev.*, **74**, 1714–19 (*Dec.* 1, 1948).—The thermal charges and voltages which arise in a piezoelectric material because of its heat energy have been computed. The calculations were made for a quartz bar, and include also some of the effects of the measuring circuit. Measurements of the thermal noise voltage of a quartz bar having a natural frequency of 36·6 kc/s were made with a specially shielded and filtered amplifier. Completely successful separation of the thermal voltage from the first-stage tube noises was not achieved. However, fairly good agreement between measured and computed crystal thermal voltage was obtained with one amplifier when it was adjusted to have a high input impedance. Measurement of the thermal voltage appears to offer a means of securing rough values of piezoelectric coefficients at room temperature and higher. A.

536.531 : 537.312.6 : 621.316.8

Thermistor thermometer. *See Abstr.* 2513

536.587 : 621.316.74.076.7

2480. Revisions for a precision high temperature control unit. STEINGISER, S., ROSENBLIT, G. J. AND WARING, C. E. *Rev. Sci. Instrum.*, **19**, 815–16 (*Nov.*, 1948).—Describes practical improvements which have been made after some years' experience with the circuit [Abstr. 1953 B (1929), 1194 B (1933), 2056 B (1943)]. Intermittent failure of regulation caused by supply-voltage variations has been overcome by supplying the equipment from constant-voltage transformers. P. R. J. F. (R)

536.62

2481. Circuits for minimizing transient effects on energy measurements in calorimetry. HOGE, H. J. *Rev. Sci. Instrum.*, **20**, 59–61 (*Jan.*, 1949).—Transient effects on electrical energy measurements in calorimetry will be minimized if P, the power developed in the heater, satisfies the condition $dP/dR = 0$, where R is the resistance in which the power is developed. This condition is satisfied if the resistance U between the two points of the supply network to which R is connected $= R$. Circuits for maintaining this condition are described. A.

536.656 : 542.952.6

2482. The heat and free energy of polymerization of ethylene. JESSUP, R. S. *J. Chem. Phys.*, **16**, 661–4 (*July*, 1948).—The quantities are calculated for the polymerization of gaseous ethylene to gaseous, straight-chain polyethylene (mono-olefin) molecules of various lengths. Equations are given expressing these properties at 25°C as functions of n, the number of ethylene units per polymer molecule, for $n \geqslant 3$. The limiting values at 25°C for long-chain molecules are $\Delta H_p^\circ = -22{\cdot}348$ kcal. per ethylene unit, $\Delta F_p^\circ = -12{\cdot}186$ kcal. per ethylene unit. A preliminary value for the heat of combustion of solid polyethylene at 25°C, $\Delta H_c^\circ = -311{\cdot}8$ kcal. per ethylene unit, is combined with other data to obtain the value $\Delta H_p^\circ = -25{\cdot}4$ kcal. per ethylene unit for the heat of polymerization of gaseous ethylene to solid polyethylene. The experimental and calculated values for gaseous polyethylene are consistent within reasonable limits when account is taken of the heat of sublimation of the partly crystalline polyethylene, estimated to be 3·6 kcal. per ethylene unit. Values are given graphically and in tabular form for the equilibrium concentrations of ethylene and all its polymers at various temperatures in a mixture in the ideal gas state at a pressure of 1 atmos. A.

THERMODYNAMICS 536.7/.8

536.7

2483. The thermodynamic properties of sodium silicate. MCCREADY, N. W. *J. Phys. Coll. Chem.*,

52, 1277–83 (*Nov.*, 1948).—The thermal and equilibrium data on sodium silicates are reviewed and the most probable values for the heats and free energies of formation at 25°C calculated for Na_4SiO_4, $Na_6Si_2O_7$, Na_2SiO_3 and $Na_2Si_2O_5$. Estimated values are obtained for vitreous sodium silicate. Values for the various forms of silica consistent with these are also listed. F. E. H.

536.7 : 541.135.5

Thermodynamic theory of the electrical double layer at an ideal polarized electrode. *See Abstr.* 2774

536.7 : 548.528 : 536.422

The validity of the Thomson–Gibbs equation. *See Abstr.* 2797

536.75 : 536.63

2484. Heat capacities at low temperatures and entropies of vanadium carbide and vanadium nitride. SHOMATE, C. H. AND KELLEY, K. K. *J. Amer. Chem. Soc.*, **71**, 314–15 (*Jan.*, 1949).—The heat capacities of vanadium carbide and nitride were measured throughout the temperature range 50·4–298·16°K. The entropies of vanadium carbide and nitride are, respectively, $S^\circ_{298\cdot16} = 6\cdot77 \pm 0\cdot03$ and $S^\circ_{298\cdot16} = 8\cdot91 \pm 0\cdot04$. The corresponding entropies of formation from the elements are $\Delta S^\circ_{298\cdot16} = -1\cdot6 \pm 0\cdot1$ and $\Delta S_{298\cdot16} = -21\cdot0 \pm 0\cdot1$. A.

536.75 : 536.63

2485. High temperature heat contents of vanadium carbide and vanadium nitride. KING, E. G. *J. Amer. Chem. Soc.*, **71**, 316–17 (*Jan.*, 1949).—High temp. heat contents above 298·16°K of VC and VN were measured from about 400° to 1 611°K. A table of heat content and entropy increments above 298·16°K is given, and heat content and heat capacity equations are derived. A.

536.77 : 539.132

The thermodynamic functions of the fourth power oscillator. *See Abstr.* 2637

536.782

2486. Measurement of the Joule–Thomson effect of air and oxygen at low pressures. BRILLIANTOV, N. A. *J. Tech. Phys., USSR*, **18**, 1113–22 (*Sept.*, 1948) *In Russian.*—There are no data of satisfactory accuracy available for plotting T–S diagrams of air usable for the pressure range below 25 atm. and for temps. of 90–160°K. A suitable instrument and method, developed by the author, are described in great detail, and tabulated and graphed results of the measurements are given. B. F. K.

ELECTRICITY 537

THEORY ELECTRONS 537.1

537.12/.13 : 539.163.2 : 539.165.1

Positron/negatron ratio in the decay of Cl^{36}. *See Abstr.* 2679

537.122 : 530.145

Self-energy of the bound electron. *See Abstr.* 2337

537.122 : 538.11

2487. Kinetics of the diamagnetism of free electrons. GORENSTEIN, I. V. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 2) 164–7 (1949) *In Russian.*—Statistically unstable magnetic moments, induced by a variable (alternating) magnetic field in a free electron gas confined between potential barriers, are investigated. B. F. K.

537.13 : 539.153

2488. Life-time of slow positrons. POMERANCHUK, I. Letter in *J. Exp. Theor. Phys., USSR*, **19** (*No.* 2) 183–4 (1949) *In Russian.*—The conventional method of calculating the life-time of slow positrons is criticized as not considering the repelling forces acting on a positron inside the atom, owing to which the positron is unable to penetrate to the outside of the atom, to be annihilated by the outer electrons. The retardation of nearly all positrons down to energies of only a few electron volts is pointed out. These are the lower energy levels of the positrons in condensed substances, and are determined by the Coulomb energy of the positron between the atoms of a crystal. In such condensed substances the positrons at their annihilation have kinetic energies of the same order. Here the annihilation is due to the outer electrons. An improved theory is given and is shown to find application to the annihilation of positrons in gases. B. F. K.

537.13 : 539.166.84 : 537.534.8

Angular distribution of γ-quanta from the annihilation of positrons. *See Abstr.* 2694

537.13 : 539.185 : 530.145

The magnetic moment of the proton. *See Abstr.* 2341

537.133 : 539.152.1 : 539.185

Non-central interactions between neutron and proton. *See Abstr.* 2653

ELECTROSTATICS . DIELECTRICS 537.2

537.212 : 621.317.729

2489. Automatic plotting of electrostatic fields. GREEN, P. E., JR. *Rev. Sci. Instrum.*, **19**, 646–53 (*Oct.*, 1948).—An apparatus is described by means of which plots of the equipotentials of 2-dimensional fields may be made automatically from models of the electrodes. The usual electrolytic tank method has been extended by the addition of a servomechanism which causes the probe to traverse an equipotential automatically. A stepping relay operated by a limit switch effects automatic plotting of successive equipotentials and limits the plot to a desired area. A number of plots made with such an apparatus are reproduced. A.

537.221 : 532.528 : 534.321.9

The electric field in cavities produced by ultrasonic waves in liquids. *See Abstr.* 2359

537.222 : 550.837

2490. Field of a point source of current situated on the earth's surface above an inclined stratum. SKALSKAYA, I. P. *J. Tech. Phys., USSR*, **18**, 1242–54 (*Oct.*, 1948) *In Russian.*—The problem, which is of interest

for electric prospecting, was treated by Tikhonov (Papers of *Inst. Theor. Geophys.*, **1**, 116 (1946)], and its electrostatic equivalent by Grünberg [*J. Exp. Theor. Phys.*, **10**, 1087 (1940)], who gave an exact solution of the integral equation to which the problem can be reduced. The author gives a direct solution by varying Grünberg's method in such a way that integral transformations can be applied immediately to the initial differential equations. This permits of obtaining the exact solution in a compact form involving real integrals only. Particularly simple expressions for the potential distribution on the earth's surface result in the case when the angle α between the surface and the stratum is a rational fraction of π. The integrals then contain only elementary functions as arguments. The formulae are thus convenient for numerical evaluation and enable some results of a general character to be given, e.g. asymptotic expressions for potentials at large distances from the source. B. F. K.

537.226

2491. Theory of polarization of dipolar liquids. Anselm, A. I. *J. Tech. Phys., USSR*, **18**, 1095–112 (*Sept.*, 1948) *In Russian.*—A critical review of the various theories of polarization in constant electric fields. The theories surveyed and compared are those of Debye, Onsager, Kirkwood and the author's own work. The basic assumptions of Debye's theory of the internal molecular field are shown to be incorrect. No claim to completeness is made for the survey. (19 references.) B. F. K.

537.226

2492. Theoretical model for explaining the ferroelectric effect in barium titanate. Mason, W. P. and Matthias, B. T. *Phys. Rev.*, **74**, 1622–39 (*Dec.* 1, 1948).—To explain the properties of a Ba titanate single domain crystal, a previous theory of the ferroelectric effect in rochelle salt [Abstr. 324 (1948)] has been extended to the 3-dimensional structure of barium titanate. This involves 6 equilibrium positions and results in significant differences from the single bond type of structure of rochelle salt. The theoretical features considered are a calculation of the spontaneous polarization as a function of temperature, the dielectric constant along the $a = y$ and $c = z$ axes as a function of temperature, the relaxation of the dielectric constant at high frequencies, and the hysteresis loops. All of these features are explained by the model considered here. A.

537.226

2493. A new form of dielectric polarization and losses in polycrystalline media. Skanavi, G. I. and Demeshina, A. I. *J. Exp. Theor. Phys., USSR*, **19**, 3–17 (*Jan.*, 1949) *In Russian.*—Dielectric permittivity and loss angle of polycrystalline rutile, containing admixtures of oxides of the 2nd group of the periodic system, were determined at various temps. and frequencies. It is shown that the permittivity at low frequencies (up to 10–20 kc/s) reaches very high values (of the order of 1 000) for rutile specimens with small admixtures of Sr, Ca, Ba and Zn. The loss angle, having a high value, has marked temperature-frequency maxima. With an increase in the concentration of the alkaline earth metals the observed effect subsides. The experimental results are in a 1st approximation agreement with the theory of relaxation polarization and losses due to weakly bound ions developed in earlier papers. The activation energy of the loosely bound ions and frequency of their oscillations about their points of fixation, as calculated on the experimental data, show abnormally low values. Thus a new type of dielectric polarization has been experimentally established, revealing very high dielectric constants of polycrystalline dielectrics with loosened crystal lattice. B. F. K.

537.226

2494. Polarization and piezo-effect of barium titanate near the Seignette-salt transition point. Ginsburg, V. L. *J. Exp. Theor. Phys., USSR*, **19**, 36–41 (*Jan.*, 1949) *In Russian.*—The question is considered theoretically for barium-titanate monocrystals. The dispersion of the dielectric constant of these crystals near the Curie-point is also treated. B. F. K.

537.226 : 548.735.7

Domain orientation in $BaTiO_3$ by electric fields. *See Abstr.* 2811

537.226 : 621.315.612.011.5

2495. The variation of the dielectric properties of magnesium orthotitanate base ceramics and their representation by the logarithmic law of mixtures. Albers-Schœnberg, E. and Soyck, W. *Ann. Radioélectricité*, **3**, 290–2 (*Oct.*, 1948) *In French.*—A curve is plotted, on a log scale, of the permittivity of Mg orthotitanate against the % by volume of other titanates. A second curve shows the variation of permittivity with temperature.

537.226 : 621.315.615.011.5

2496. Dielectric strength of liquids for short pulses of voltage. Macfadyen, K. A. and Edwards, W. D. Letter in *Nature, Lond.*, **163**, 171–2 (*Jan.* 29, 1949).—The dielectric strength of pure benzene and alcohol shows a systematic increase as the duration of the pulse of the voltage is decreased; i.e., the time-delay between the instant of applying the field and the instant of breakdown decreases as the field strength is raised above the normal breakdown value. E. R. (R)

537.226.1

2497. Dielectric behavior of solutions of electrolytes in solvents of low dielectric constant. III. The influence of constitution on dielectric absorption. Strobel, H. A. and Eckstrom, H. C. *J. Chem. Phys.*, **16**, 817–26 (*Aug.*, 1948).—A study of the influence of constitutional factors on the dielectric absorption of a variety of long chain salts in benzene solution was made by a calorimetric method. In a series of octadecyltributylammonium salts, absorption at a given concentration proved dependent on the constitution of the anion. Two salt series in which the chloride and thiocyanate anions were combined with different cations showed a marked dependence of absorption and of calculated aggregate dimensions on the size of the positive ions. All solutions below about 0·005 molar behaved as monodisperse systems; at about 0·01 molar additional varieties of ion clusters appeared to become stable and the systems were highly polydispersed; at somewhat higher concentrations there was evidence that a few types of aggregates were predominating and that the complexity was being reduced. On the basis of Debye

theory, critical frequencies, average aggregate radii, and dipole moments were evaluated wherever feasible. The results are in good agreement with such polarization and conductance data as are available. A.

537.226.1 : 541.133

2498. Dielectric behavior of solutions of electrolytes in solvents of low dielectric constant. IV. A. Dielectric absorption of butyl alcohol. B. The second Wien effect. STROBEL, H. A. AND ECKSTROM, H. C. *J. Chem. Phys.*, **16**, 828–31 (*Aug.*, 1948).—The absorption conductivity of *n*-butyl alcohol was determined by a calorimetric method, using two independent, specially purified samples. Its dielectric behaviour proved to be in good agreement with the Debye theory. The probable source of the error in earlier butyl alcohol measurements determined with the same apparatus was ascertained. A critical frequency of 305 Mc/s was calculated. Several benzene solutions between 0·001–0·008 molar showed increases in conductance with field strength at 60 c/s in accord with Onsager's theoretical treatment of the second Wien effect. A.

537.226.1

2499. Anomalous dispersion of dielectric constant. JATKAR, S. K. K. AND IYENGAR, B. R. Y. *Indian J. Phys.*, **22**, 437–46 (*Oct.*, 1948).—The authors' new polarization equation [*J. Ind. Inst. Sci.*, **28 A**, *Pt II*, 1–15 (1946)] $P(\omega) = (\varepsilon - 1)M/d = (4\pi N/3)\,[\alpha_E + \mu^2/kT(1 + i\omega\tau)]$ is shown to lead to $\varepsilon' = \varepsilon_\infty + (\varepsilon_0 - \varepsilon_\infty)/(1 + \omega^2\tau^2)$ and $\varepsilon'' = (\varepsilon_0 - \varepsilon_\infty)\omega\tau/(1 + \omega^2\tau^2)$ and is extended to mixtures and to the case of a distribution of relaxation times. D. H. W.

537.226.1 : 621.317.37.029.6

2500. Measurement of the permittivities of solid dielectrics in the cm band. STAROBINSKI, A. T. *J. Tech. Phys., USSR*, **17**, 1209–14 (*Oct.*, 1947) *In Russian.*—The method of measuring permittivity by taking field distribution curves along a waveguide, near whose closed end the dielectric is placed, is considered theoretically. The permittivity of 3 dielectrics for 10 cm wavelength was determined with satisfactory accuracy. An improved approximation of the conditions at the open end to those in the free space consists in placing a film of the dielectric in the waveguide at an appropriate distance from its open end. A.

537.226.2

2501. Observation of the ferro-electric Barkhausen effect in barium titanate. NEWTON, R. R., AHEARN, A. J. AND MCKAY, K. G. *Phys. Rev.*, **75**, 103–6 (*Jan.* 1, 1949).—Conductivity pulses were observed immediately after a single crystal of $BaTiO_3$ was placed in an electric field, but died out in a few seconds. Several experiments were designed to test the hypothesis that these pulses were caused by the Barkhausen effect. From the experiments, the volume of a Barkhausen region and the apparent velocity of a domain wall could be estimated. A.

537.226.31 : 547.96

2502. Dielectric constants of proteins. JATKAR, S. K. K. AND IYENGAR, B. R. Y. *Indian J. Phys.*, **22**, 453–60 (*Oct.*, 1948).—Application of the new equation $(\varepsilon - n^2)M/d = 4\pi N\mu^2/kT$ to published data on proteins reduces the μ values slightly (e.g. from 510 to 422 *D* for an albumin). Molecular radii are calculated using the Stokes–Debye expression for the relaxation time (e.g. 41·1 Å is found for the radius of the albumin) and the dipole moments are shown to be approximately equal to the protein diameter × the electronic charge (which = 392 *D* for the albumin). [See also Abstr. 2499 (1949)]. D. H. W.

537.228.1 : 530.162 : 621.396.822 : 536.53

Thermal voltages of a quartz crystal. *See Abstr.* 2479

537.228.1 : 534.232

Low loss crystal systems. *See Abstr.* 2396

537.228.1 : 539.32

2503. Calculation of the piezo-electric constants of α-quartz on Born's theory. SAXENA, B. D. AND SRIVASTAVA, K. G. *Indian J. Phys.*, **22**, 475–82 (*Nov.*, 1948).—The relationship between the piezoelectric, dielectric and elastic constants has been obtained on Born's method and it has been shown that by using a generalized system of force-constants, results are obtained which are much nearer the observed values than those obtained on Born's assumption of the validity of Cauchy's relationship. Using only 4 force-constants, calculations have been made of 17 other constants in approximate agreement with observed values, namely 2 piezoelectric constants, 7 elastic constants and 8 Raman and infrared frequencies. The calculated values of the piezoelectric constants are $\varepsilon_{11} = 7{\cdot}56 \times 10^4$ and $\varepsilon_{41} = 3{\cdot}18 \times 10^4$ (obs. $5{\cdot}1 \times 10^4$ and $1{\cdot}23 \times 10^4$). A.

537.228.1 : 621.396.611.21

2504. A sensitive apparatus for qualitative testing of crystals on piezoelectricity. PERDOK, W. G. AND VAN SUCHTELEN, H. *Appl. Sci. Res.*, **B 1** (*No.* 3) 195–204 (1948) *In English.*—An apparatus for qualitative testing of piezoelectric crystals, based on the principle of Giebe and Scheibe [*Z. Phys.*, **33**, 760 (1925)] is described. It is easily built and functions very constantly and reliably. The instrument may be of interest in X-ray diffraction to determine whether crystals lack a centre of symmetry. A.

ELECTRIC CONDUCTION . CURRENTS 537.3

537.311

2505. A calculation of the changes in the conductivity of metals produced by cold-work. KOEHLER, J. S. *Phys. Rev.*, **75**, 106–17 (*Jan.* 1, 1949).—The increase in the electrical resistance of severely cold-worked metals has been calculated by assuming that it is due to the introduction of large numbers of Taylor dislocations. The calculated increase in the electrical resistance of polycrystalline Cu is in good agreement with the measured value. The calculations show that for single crystals there is a decided dependence of the dislocation resistance on the orientation of the electric field relative to the crystallographic axes. In Cu the ratio of the largest dislocation resistance to the smallest is 8. This ratio is large for materials having a small Poisson's ratio. It is found that if the dislocations are not too closely clustered no interference effects will occur. The detailed calculations for Cu assume that clustering is unimportant. Measurements on single crystals are in progress. A.

537.311

2506. Theory of electrical conductivity of monovalent metals. SEROVA, F. G. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 2) 126–34 (1949) *In Russian.*—It is shown that when the wave functions of the conductivity electrons generally used in the calculation of bond forces and other characteristics of monovalent metals are applied to the calculation of the electric conductivity, the results are as follows: for Li a considerably better agreement of the calculated and the experimental values than that obtained by Bardeen [Abstr. 5069 (1937)] in his calculation with plane waves, and for Na and K practically an equally good result as Bardeen's. B. F. K.

537.311 : 537.122

2507. Conductivity induced by electron bombardment in thin insulating films. PENSAK, L. *Phys. Rev.*, **75**, 472–8 (*Feb.* 1, 1949).—When thin films of insulating material are bombarded by high velocity electron beams that can penetrate through the thickness of the film, steady currents can be obtained that are as much as 100 times that in the bombarding beam. These currents vary with the gradient across the film and are proportional to the fraction of the beam energy absorbed in the film. Typical data obtained with amorphous silica are presented, together with a description of the experimental procedures that were used. A.

537.311 : 549.211

2508. Electron bombardment conductivity in diamond. MCKAY, K. G. *Phys. Rev.*, **74**, 1606–21 (*Dec.* 1, 1948).—A study has been made of electron bombardment conductivity in diamond using primary electrons of energies up to 14 keV. An alternating field method is used which reduces or eliminates the effects of internal space-charge fields. Data on internal yields as a function of crystal field are given for both electron and positive hole carriers. Internal yields as high as 600 have been attained. The experimental curves are fitted to a theoretical curve for the space-charge-free crystal from which are derived reasonable values for the number of electrons produced in the conduction band per incident primary electron, the probable life time of the conduction electrons and the crystal trap density. Experiments are described which lead to a hypothesis of space-charge neutralization. A possible cause of the current fluctuations observed at high crystal fields is discussed. A.

537.311.1 : 539.23

2509. The resistivity of thin metallic films. WEALE, R. A. *Proc. Phys. Soc., Lond.*, **62A**, 135–6 (*Feb.* 1, 1949).—Non-elastic collisions are assumed to take place between the conducting electrons and the boundary faces of a thin metallic film, and Planck's empirical formula relating the resistivity of the film, that of the metal in bulk, and the film thickness is deduced. The expression leads to a reduced temp. coefficient of resistivity which can become zero and negative, and explains results on Ni and Bi films as found in the literature. R. A. W.

537.311.33

2510. Rectification on the boundary of two semiconductors. JOFFE, A. V. *J. Tech. Phys., USSR*, **18**, 1498–510 (*Dec.*, 1948) *In Russian.*—Experiments show a high degree of rectification at the interface of two semi-conductors in simple contact without thermal treatment on condition that they have different conduction mechanisms and contact potentials. Rectification is due to blocking layers in the presence of different contact potentials, the thickness of which varies during passage of the current. L. J. G.

537.312.5 : 535.215

2511. Spectral distribution of the photo-effect in Sb–Cs photocells with u.v. window in the range 2 483–5 790 Å. BARSHCHEVSKI, B. A. Letter in *J. Tech. Phys., USSR*, **18**, 1230–1 (*Sept.*, 1948) *In Russian.*

537.312.5 : 536.521

2512. Temperature coefficient of sensitivity of lead sulphide photo-conductive cells at room temperature. CARLISLE, S. S. AND ALDERTON, G. *Nature, Lond.*, **163**, 529–30 (*April* 2, 1949).—In applications of PbS cells to industrial radiation pyrometry the temperatures of the sources (350–670°C) cause variations of the photocell temperatures (16–46°C) which latter have only a negligible effect on the accuracy of the pyrometer readings. W. S.

537.312.5 : 548.0 : 535

Photoconductivity of coloured alkali-halide crystals: time and temperature dependence. *See Abstr.* 2794

537.312.6 : 536.531 : 621.316.8

2513. Investigation of uranium oxide thermistors. PRIGENT, J. *J. Phys. Radium*, **10**, 58–64 (*Feb.*, 1949) *In French.*—Amorphous UO_2 is preferred, as it makes better contact than the crystalline form; details of the method of preparation from uranyl nitrate are given. Resistance is found to vary with pressure according to $1/R = cP^{\frac{1}{2}} - C$, c and C being constants for a given thermistor. Resistances in opposite directions vary by about 1 in 500. Resistance decreases with time at first, taking 30 min to reach a constant value 5% < the original value. Resistance at 50 V is $\sim \frac{1}{2}$ that at 1 V. Resistance at 100°C is $\sim \frac{1}{4}$ that at 50°C. Thermistors may be used as resistance thermometers reading to 1/160°C, or as sensitive infrared bolometers. Their high resistance makes them unsuitable for cm-wave detectors. N. C.

537.312.62

2514. On the surface energy and the behaviour of superconductors of small dimensions. GINSBURG, V. *J. Phys., USSR*, **9** (*No.* 4) 305–11 (1945) *In English.*—The thermodynamics of the transition from normal to superconductivity of bodies of small dimensions is discussed. It is shown that the interpretation of Appleyard *et al.* [Abstr. 4134 (1939)] of their measurements of critical magnetic fields of thin Hg films is modified if the difference between the surface free energies of the normal and superconductive phases is taken into account. The temperature-dependence of the penetration depth and of this difference of surface energy is estimated from the thin film results; the results do not agree well with those of Shoenberg [Abstr. 1630 (1940)]. D. S.

537.312.62

2515. Investigation of the structure in the intermediate state of a sphere of superconducting material. MESHKOVSKI, A. *J. Exp. Theor. Phys., USSR*, **19**, 54–62 (*Jan.*, 1949) *In Russian.*—The structure of the

gions of intermediate state of a tin sphere was vestigated by measuring the field strength at various oints between the two hemispheres by means of a ery small Bi probe. 2-dimensional maps of the istribution of the regions over the equatorial section f the sphere during the transitions of the specimen rom the superconducting condition into that of ormal conductivity and vice versa are given. B. F. K.

537.312.62

2516. Note on a theorem of Bloch concerning possible auses of superconductivity. BOHM, D. *Phys. Rev.*, 5, 502–4 (*Feb.* 1, 1949).—Bloch's theorem shows that ven when interelectronic interactions are taken into ccount, the state of lowest electronic free energy orresponds to a zero net current. This result ontradicts the hypothesis that superconductivity is aused by spontaneous currents. A.

537.312.8 : 538.63

Magneto-resistance of bismuth fibres. *See Abstr.* 625–6 (2)

537.312.9 : 669

2517. Change of electrical resistance of alloys during geing. MATYÁŠ, Z. *Phil. Mag.*, **40**, 324–37 (*March*, 949).—The mechanism by which the conduction lectrons in pure Al are scattered when an external ield is applied is explained. The results are appled o dilute solid solutions of Al, and this allows the hange of resistance during ageing to be predicted. Two alloys are considered, duraluminium and Al–Ag lloy in two different stages of ageing. In each case he qualitative predictions of the theory are in agreement with experiment and the quantitative results are of the correct order of magnitude. A.

537.32

2518. Variation with oxygen pressure of the thermoelectric power of cadmium oxide. HOGARTH, C. A. AND ANDREWS, J. P. *Phil. Mag.*, **40**, 273–82 (*March*, 1949).—Experiments are described which show that (*a*) over the temp. range 240°–570°C, the thermoelectric power of a CdO/Pt couple varies with the absolute temperature T, according to the equation $dE/dT = -a + b/T$, the pressure of the O in the surrounding atmosphere remaining constant; and (*b*) at const. temp. the power is a linear function of the log of the O pressure. Simple theory predicts this form of variation but not the correct values of the consts. The quantity b varies smoothly with the O pressure. A.

537.32

2519. Note on the effect of impurities and cold work on the thermoelectric power of aluminium. GALT, J. K. *Phil. Mag.*, **40**, 309–14 (*March*, 1949).—Recent observations on the thermoelectric power of impure Al are discussed theoretically. Dissolved impurities produce a change in the thermoelectric power of pure Al which can be understood in terms of the electronic band structure of Al. When the impure Al is cold worked, the variation of its power with time and temperature is changed. An explanation of this in terms of the theory of dislocations is proposed. A.

537.362

2520. Electric osmosis. DARMOIS, E. *C.R. Acad. Sci., Paris*, **227**, 339–41 (*Aug.* 2, 1948) *In French.*—The Helmholtz hypothesis that a double layer of electricity, similar to that present between two metals, also exists at the contact of any two bodies whatever, has already been criticized by the author, who ascribes it to surface friction, and he now extends his viewpoint to the case when one of the two bodies is a liquid. Here the interpretation proposed depends upon the attraction of water by ions and is illustrated by a simple experiment based on electric osmosis. H. H. HO.

ELECTRIC DISCHARGES 537.52

537.52

2521. Influence of the discharge parameters on the intensity of the mercury resonance lines 1 850 Å and 2 537 Å. BUTAEVA, F. A. AND FABRIKANT, V. A. *J. Tech. Phys., USSR*, **18**, 1127–35 (*Sept.*, 1948) *In Russian.*—The influence of current intensity, vapour pressure and argon pressure on the intensity of the lines 1 850 Å and 2 357 Å was determined by means of a vacuum luminescence spectrophotometer. The intensity of the 1 850 line rises linearly with current, whereas for the 2 537 line considerable deviations from linearity were observed. The operating conditions of luminescent lamps correspond to the max. intensity of both lines. B. F. K.

537.52

2522. Voltage drop on the discharge electrodes in inert gases. KARELINA, N. A. AND KLARFELD, B. N. *J. Tech. Phys., USSR*, **18**, 1235–41 (*Oct.*, 1948) *In Russian.*—The investigation dealt with arc discharges in He, Ne and A, and the dependence of the voltage drop on electrode distance. A deformation of the positive column produced by optional means exhibits the characteristics of the cathode, viz. the voltage drop in the discharge varies, when approaching the anode to the point of distortion of the column, in a way similar to that produced by mutual approach of the electrodes in a non-excited discharge. Probe measurements made in the near-anode space of the discharge may be affected by considerable errors unless the necessary precautions are taken. B. F. K.

537.52 : 535.332

2523. Displacement and outline of ion lines in the positive gas discharge column. FRISCH, S. E. AND KAGAN, Y. M. *Izv. Akad. Nauk, SSSR* (*Ser. Fiz.*) **12**, 358–61 (*July–Aug.*, 1948) *In Russian.*—According to a previous paper [*J. Exp. Theor. Phys.*, **17**, 577 (1947)] the displacement and outline of the spectrum lines of ions give sufficient data for characterizing the motion of positive ions in the plasma of the gas discharge. In addition to A ions previously investigated, research work has been carried out with Kr and X ions. Ionic velocities increase when pressure is decreased and, after attaining a maximum value, decrease at low pressures. Fair agreement has been found between the experimentally determined ½-width values of ion lines and the values calculated in accordance with Fock [Abstr. 1465 (1949)]. F. L.

537.52 : 535.333

2524. On the emission spectrum of chlorine under conditions productive of Joshi-effect. DEO, P. G. *Phil. Mag.*, **39**, 978–84 (*Dec.*, 1948).—Radiation of Cl subjected to the silent electric discharge was studied

spectroscopically in the visible region. The spectrum consists of faint bands degraded towards the red; an intensity max. occurs in regions 4 900–4 400 Å and 5 800–5 500 Å, and a number of new bands in the red were observed. It is suggested that the emission is due to Cl_2^+. L. S. G.

537.52 : 537.56 : 621.396.611.4

2525. Microwave breakdown of a gas in a cylindrical cavity of arbitrary length. HERLIN, M. A. AND BROWN, S. C. *Phys. Rev.*, **74**, 1650–6 (*Dec.* 1, 1948).—It is possible to consider breakdown in a cylindrical microwave cavity whose radius ≫ length as approaching the conditions of parallel plate breakdown. This assumption has been used to measure high frequency ionization coefficients. The paper investigates the corrections to be made when the length is increased. Numerical results are given for cavities whose ratios of radius to length are as low as 0·5, and the method is applicable to any cylindrical cavity. The breakdown data in these longer cavities are used to extend the high frequency ionization coefficient curves for air by a factor of 10. A.

537.521.7

2526. The mechanism of spark luminosity. RAISKI, S. M. *J. Exp. Theor. Phys., USSR*, **18**, 941–3 (*Oct.*, 1948) *In Russian.*—The dimensions of the part of the electrode affected by the spark ("trace" of the spark) are determined by the diameter of the spark canal in air. The part of the electrode first affected is that with which the spark canal makes contact at the instant of puncture, then, as the canal widens, parts of the electrode more remote from the point of puncture become involved. The velocity of spreading of the "trace" on the electrode surface keeps pace with the widening of the spark canal. A.

537.523

2527. Studies in high frequency discharges. LODGE, J. I. AND STEWART, R. W. *Canad. J. Res. A*, **26**, 205–29 (*July*, 1948).—Experiments are described in which semi-transparent films of Ag, Cu, Al, Au and Bi in cylindrical tubes were subjected to ionic bombardment in air. In all cases removal of metal from the film was observed and the metal was deposited elsewhere in the tube: similar effects were observed near the cathode in d.c. discharges. Observed thicknesses of deposits thus produced agreed with those calculated on the assumption that the metal removed at one end diffused along the tube. A qualitative theory of h.f. discharges is outlined based on well-known principles of equal ambi-polar radial diffusion to the walls and the dependence of mean electron energies on the field strength. F. LL. J.

537.523.4 : 551.594–221

Mechanism of lightning discharge. *See Abstr.* 2837

537.525

2528. High frequency gas discharge breakdown in helium. MACDONALD, A. D. AND BROWN, S. C. *Phys. Rev.*, **75**, 411–18 (*Feb.* 1, 1949).—Breakdown electric fields in low pressure He at high frequencies have been theoretically predicted and experimentally verified. The energy distribution of electrons is derived from the Boltzmann transport equation, taking into account all significant removal processes. The distribution function is expanded in spherical harmonics and the resulting second order linear differential equation is solved in terms of the confluent hypergeometric function. This distribution function combined with kinetic theory formulae permits calculation of the ionization rate and the electron diffusion coefficient. From these the high frequency ionization coefficient is determined. Through the diffusion equation this ionization coefficient is related to breakdown electric fields. Thus breakdown electric fields are predicted theoretically without using any gas discharge data other than experimental values of the excitation potential and collision cross-section of He. Breakdown electric fields are measured for He in microwave cavities of various sizes with a large range of pressure. The theoretical electric fields, involving no adjustable parameters, are checked within the maximum experimental error of 6%. A.

537.525

2529. Breakdown probability of a low pressure gas discharge. WIJSMAN, R. A. *Phys. Rev.*, **75**, 833–7 (*March* 1, 1949).—The probability distribution of the number of electrons in an "avalanche" in a low-pressure gas discharge is calculated and the result applied to the calculation of the breakdown probability. Under some simplifying assumptions the probability P_0 that the avalanche caused by one initial electron, liberated from the cathode, leads to breakdown is found to be $P_0 = 1 - 1/q$ if $q > 1$ and $P_0 = 0$ if $q < 1$, in which $q = \gamma(\exp[\int_0^d \alpha(x')dx'] - 1)$ is the average number of secondary electrons liberated at the cathode as a result of the avalanche of the initial electron. The calculation has been generalized to the case that the initial electron is liberated in the gas. Finally the relation between the breakdown probability P_0 and the statistical distribution of sparking time lags is discussed. A.

537.525 : 537.311.37

2530. Electron velocity distribution function in high frequency alternating fields including electronic interactions. CAHN, J. H. *Phys. Rev.*, **75**, 838–41 (*March* 1, 1949).—The Boltzmann transport equation has been solved for the electronic velocity distribution function in a high frequency gas discharge. The distribution is examined as a function of the electron density. The conductivity is computed for 2 electron-molecule cross-sections, (1) in which the cross-section is inversely proportional to the electron velocity, and (2) in which the cross-section is independent of electron energy. The results show the extension of Margenau's distribution to high densities. A.

537.525.3

2531. Influence of series Geissler tubes on the production of Joshi-effect in an ozoniser discharge. PRASAD, B. N. AND NATH, N. *Indian J. Phys.*, **22**, 466–74 (*Oct.*, 1948).—The Joshi effect [see Abstr. 1786, 2049, 2566 (1944)] is the decrease in mean current through a discharge when the latter is irradiated by an external means. It is marked in, e.g., Cl and appears to be connected with the presence of discontinuous ("corona") currents in the discharge. The present paper describes further experiments with ozonizer tubes, with and without series tubes containing N, Ne or He. The results are described in detail; no exact interpretation seems possible at present. J. D. C.

537.525.8

2532. Phenomena of high frequency discharge. MEHTA, G. K. *J. Univ. Bombay*, **16**, 63–78 (*March*, 1948).—A review of theoretical and experimental work on h.f. discharges with or without internal electrodes. 66 references are given. J. D. C.

537.525.9

2533. On the production of steady e.m.f.'s by h.f. discharges. CHENOT, M. *C.R. Acad. Sci., Paris*, **227**, 45–6 (*July* 5, 1948) *In French.*—Describes briefly the p.d.'s established between metallic electrodes immersed in h.f. (50–100 Mc/s) discharges in H (press. of $< 10^{-2}$ mm Hg). The discharges are excited with electrodes external to the tube. A short discussion is given. J. D. C.

X-RAYS 537.531

537.531

2534. A precision study of the tungsten *K* spectrum using the 2-meter focusing curved crystal spectrometer. WATSON, B. B., WEST, W. J., LIND, D. A. AND DUMOND, J. W. M. *Phys. Rev.*, **75**, 505–12 (*Feb.* 1, 1949).—Careful measurements were made of the wavelengths of the *K* series lines and *K* absorption edge of W with a 2-meter focusing curved crystal γ-ray spectrometer. The high precision, resolution and luminosity of the instrument made possible the complete resolution of the β-doublet, the partial resolution of the γ-doublet, and the detection and measurement of a δ-line close to the absorption edge. Absolute determinations of the Bragg angles for Mo $K\alpha_1$ and W $K\alpha_1$ reflected from the (310) planes of quartz are described. A.

537.531 : 535.33

2535. The *K* spectra of element 61. BURKHART, L. E., PEED, W. F. AND SPITZER, E. J. *Phys. Rev.*, **75**, 86–9 (*Jan.* 1, 1949).—The $K\alpha_1$, $K\alpha_2$, $K\beta_1$ and $K\beta_2$ lines of the X-ray spectra of element 61 were obtained from 1·5 mg of sample of the chloride salt. The sample was fused on a Cu target and bombarded with electrons from a 70 kV source. Wavelength measurements were made from a microphotometer tracing of the film. After one exposure of the sample, Nd and Sm were added to the target and the spectrum of the 3 elements recorded to show the position of element 61 in the periodic table. A.

537.531 : 535.33.071

2536. On the width of lines in X-ray spectra. GOKHALE, B. G. *C.R. Acad. Sci., Paris*, **228**, 169–70 (*Jan.* 10, 1949) *In French.*—It is argued that in practice the Cauchois bent-crystal spectrometer gives sharper lines than the double-crystal spectrometer, though in theory the latter is preferable. Photographic measurements by the former method give half widths of 0·27 and 0·30 ± 0·01 x for Mo $K\alpha_1$ and Mo $K\alpha_2$, which are 0·02 x smaller than those previously obtained by the double-crystal method. A. J. C. W.

537.531 : 535.34

2537. The absorption of high energy quanta. I. ADAMS, G. D. *Phys. Rev.*, **74**, 1707–11 (*Dec.* 1, 1948).—The absorption of quanta between 11 and 20 MeV has been measured with the X-rays from a 22 MeV betatron as a source. The high energy tip of the X-ray spectrum has been isolated for these measurements by using a threshold detector method. The detectors used were Cu, Fe and C, with which absorption coefficient values were obtained at 11·04, 13·73 and 19·10 MeV, respectively. Al, Fe, Cu and Pb were used as absorbers. The observed absorption coefficients are in good agreement with existing theory except in the case of Pb, where the absorption is smaller than predicted. This is probably due to the failure of the Born approximation in the calculation of the pair-production cross-section. A.

537.531 : 535.34 : 614.8

2538. Broad- and narrow-beam attenuation of 500- to 1 400-kilovolt X-rays in lead and concrete. WYCKOFF, H. O., KENNEDY, R. J. AND BRADFORD, W. R. *J. Res. Nat. Bur. Stand., Wash.*, **41**, 223–30 (*Sept.*, 1948). *Radiology*, **51**, 849–59 (*Dec.*, 1948).—Both narrow- and broad-beam attenuation curves have been obtained for 500, 600, 800, 1 000 and 1 400 kV X-rays in Pb and concrete. For the experimental conditions used, it is shown that an irradiated area 12 in. in diameter for Pb absorbers and 37 in. in diameter for concrete satisfy the barrier conditions required for broad-beam attenuation curves. A.

537.531 : 535.43

2539. Interpretation of the [extrapolated] limiting value of [the intensity of] X-ray scattering at very small angles. FOURNET, G. AND GUINIER, A. *C.R. Acad. Sci., Paris*, **228**, 66–8 (*Jan.* 3, 1949) *In French.*—The actual intensity of scattering at zero angle, $N^2F^2(0)$, for N particles of scattering factor F is unobservable, and the limit approached by the observed scattering I_h as h $(= (2\pi/\lambda) \times$ angle of scattering) approaches zero is in general different. It is large for a gas, small for a liquid, and zero for perfect crystals without thermal motion. The limit I_0 is shown to be $I_e n^2(\langle N^2\rangle - \langle N\rangle^2)$, where I_e is the intensity scattered by a single electron, n is the number of electrons per particle, the angle brackets represent time averages, and N is the number of particles contained in the irradiated volume. The observable small-angle scattering is therefore a consequence of the existence of fluctuations. The fluctuation in N^2 is determined by thermodynamics in terms of compressibility χ, so that $I_0 = I_e n^2 \langle N\rangle \chi kT/v$, where v is the average volume available per particle. A. J. C. W.

537.531 : 539.152.1

An investigation of bremsstrahlung by means of the nuclear isomerism of indium. *See Abstr.* 2650

537.531 : 539.164 : 541.14

Oxidising and reducing action of X-rays. *See Abstr.* 2681

537.531 : 541.14 : 539.164

Formation of hydrogen peroxide in water by X-rays. *See Abstr.* 2780

537.531 : 548.733 : 621.386.26

2540. An X-ray tube with adjustable focus. ARNDT, U. W. *J. Sci. Instrum. Phys. Ind.*, **25**, 414–16 (*Dec.*, 1948).—An experimental cathode assembly is described, designed to be fitted to the standard target

head of a crystallographic X-ray unit, which makes it possible to obtain an adjustable focus 1 cm in length and down to $\frac{1}{3}$ mm in height, without a surrounding halo. The stability of the tube current is discussed. A.

537.531 : 614.8

2541. Protection requirements of one-million volt (1-Mv) and two-million volt (2-Mv) roentgen ray installations. BRAESTRUP, C. B. AND WYCKOFF, H. O. *Radiology*, **51**, 840–8 (*Dec.*, 1948).—Protective values for X-ray apparatus of one million volts and above have hitherto been calculated by interpolation of data for lower voltage apparatus and are mainly in relation to narrow X-ray beams of radiation. In practice protective barriers are usually exposed to wide beam radiation so that the scattered component is much greater than with narrow beams. Tests made with nine 1 MV and one 2 MV installations are described, the permissible total weekly safe radiation being taken as 0·1 r. A preliminary survey was made with Geiger counters to find regions of maximum intensity and quantitative measurements were then made with large chamber ionization meters, such measurements often being made simultaneously in 10 different positions. Details are given of the apparatus used, with polar diagrams of the intensities determined. Protection of the patient from scattered radiation is dependent on the tube construction and shielding. To reduce the cost of protection the treatment room should be on the ground and preferably with no upper room. At the present time concrete is the most convenient protective material from an economical aspect, but its scattered radiation component is high. Thicknesses of concrete recommended for 1 MV and 2 MV installations are tabulated with respect to tube currents and target distances in in. and cm. Radiation may undergo repeated scattering before reaching any particular region and is frequently above the tolerance dose. An increase of shielding of the actual tube with 100 lb protection may reduce the requisite concrete thicknesses by 6 in. B. J. L.

CATHODE RAYS . POSITIVE RAYS 537.533/.534

537.533 : 777.3

2542. The recording of electron tracks in photographic emulsions. HERZ, R. H. *Phys. Rev.*, **75**, 478–86 (*Feb.* 1, 1949).—Four different methods of obtaining electron tracks in nuclear-track plates are described. Electron tracks have been produced by X-rays, by natural radioactive decay, by exposures in an electron microscope and by feeble, induced radioactivity. A first attempt at establishing the range-energy relationship of electrons has been made from length measurements of electron tracks produced by heterogeneous and monochromatic X-rays at various kilovoltages and by monoenergetic electrons in an electron microscope. Some considerations are given on the sensitivity of the nuclear-track plate used in these experiments. A.

537.533.3

2543. A magnetic lens with curvilinear axis. HUBERT, P. *C.R. Acad. Sci., Paris*, **228**, 302–4 (*Jan.* 24, 1949) *In French.*—It is shown that it is possible to make a magnetic lens with a curvilinear axis by means of a field without rotational symmetry. Such lenses have practical advantages in β-ray spectroscopy. A. H. W. B.

537.533.3 : 538.12 : 621.385.132 : 621.317.42

An electron tube for viewing magnetic fields. *See Abstr.* 2601

537.533.3 : 621.385 : 621.317.32

2544. Factors influencing the design of a rubber model. WALKER, G. B. *Proc. Instn Elect. Engrs*, **96**, *Pt II*, 319–25 (*April*, 1949).—The rubber model has often been used in the solution of problems concerning the motion of charged particles in an electric field and in particular to the investigation of electron trajectories in radio valves. The principal causes of error in the model are discussed and, in some simple cases, evaluated. It is shown that errors due to the configuration of the membrane and ball spin can be reduced without limit by decreasing the scale of deformation of the membrane. Energy loss due to friction is the limiting factor and a method is described by which this may be measured (as a function of ball speed), results being given for balls of various sizes rolling over a pure rubber surface. In general, a reduction in the area of the membrane and an increase in the ball diameter are advantageous, subject to constructional limitations. For a path length of $\sim$1 ft and a 1 in ball dia., errors in ball energy can be maintained below 2%. A.

537.533.3 : 621.385.833

2545. Some properties of tubular electron beams. WAX, N. *J. Appl. Phys.*, **20**, 242–7 (*March*, 1949).—Approximate expressions are obtained for the potential distribution, max. c.d. and beam spread of tubular electron beams of finite thickness. Comparisons are made with previously published results for very thin tubular beams and solid cylindrical beams. A.

537.533.7 : 621.385.833

2546. Influence of space charge on the phase focusing of electron beams. LABUS, J. *Z. Naturforsch.*, **3a**, 52–61 (*Jan.*, 1948) *In German.*—An electron beam enters a velocity-bunching apparatus. A mathematical analysis, based on Poisson's equation, the equation of motion, and the continuity equation, is made of the effect of space charge on velocity bunching and the efficiency. If the space charge is $<$ a certain critical value, the efficiency is 44%; but, whatever the space charge, the efficiency cannot exceed 58%. L. S. G. (R)

537.533.72 : 621.385.83

2547. Deflection of an electron beam such that the image of the gun aperture on the screen remains a point. HACHENBERG, O. *Ann. Phys., Lpz.* (*Folge* 6) **2** (*Nos* 5–6) 225–41 (1948) *In German.*—Large angles, of the order $\pi/2$, are discussed. The deflecting system is used simultaneously for deflection and focusing. It consists of portions of the surface of revolution of concentric circular arcs, and results are given for various radii of the generating arcs. Experimental tests on various types of deflection are briefly discussed. A. H. W. B. (R)

537.533.75

2548. Discrete energy losses of moderately fast electrons by transmission through thin sheets. RUTHEMANN, G. *Ann. Phys., Lpz.* (*Folge* 6) **2** (*Nos* 3–4) 113–34 (1948) *In German.*—The energy losses suffered by a beam of 2–8 keV electrons during its passage through thin sheets (100–500 Å) of collodion, Al_2O_3, Be, Al and Ag, were investigated by a magnetic spectrometer. Discrete energy losses were observed in all cases, which were independent of the energy of the primary beam but increased with sheet thickness. J. T.

537.533.75

2549. Electron deceleration at X-ray levels. RUTHEMANN, G. *Ann. Phys., Lpz.* (*Folge* 6) **2** (*Nos.* 3–4) 135–46 (1948) *In German.*—The energy losses suffered by a beam of 6–8·5 keV electrons during its passage through a thin sheet of collodion (about 100 Å) are investigated by a magnetic spectrometer, and energy losses consequent upon the collision of electrons with the K electrons of C, O and N are detected. The relevant probabilities are estimated. J. T.

537.533.8

2550. The secondary emission of electrons by high energy electrons. TRUMP, J. G. AND VAN DE GRAAFF, R. J. *Phys. Rev.*, **75**, 44–5 (*Jan.* 1, 1949).—The secondary emission of electrons from W, steel, Al, and graphite was studied as a function of the energy of the bombarding primary electrons in the range 30–340 kV. The ratio of secondary to primary electrons was found to diminish with increasing primary energy and to increase with the atomic number of the target material. Thus, with Al the ratio diminished from 0·25 at 50 kV to 0·17 at 200 kV, while with W it diminished from 0·73 to 0·62 in the same voltage range. Study of the energy distribution of the secondary electrons showed a percentage with energies < 20 V. Most of the remainder had energies $>$ the available 800 V repressor potential and resulted mainly from elastic nuclear scattering, particularly in the case of targets of high atomic number. A.

537.534.07

2551. Mass-spectrometric detection of free radicals. ELTENTON, G. C. *J. Phys. Coll. Chem.*, **52**, 463–9 (*March*, 1948).—A description is given of an apparatus, consisting of a closely coupled reactor and mass spectrometer, suitable for the identification of intermediates occurring in thermal cracking and flame reactions. A few representative examples of the results obtained are briefly discussed. [See Abstr. 3344 (1947)]. C. B. A.

537.534.72

2552. Trochotron design principles. MONK, G. W. AND WERNER, G. K. *Rev. Sci. Instrum.*, **20**, 94–100 (*Feb.*, 1949).—A derivation of the perfect focusing properties of the trochoidal type mass spectrometer, which leads to convenient methods of correlating the many variables for design purposes, is given. Nomographs and general trochoids are given which apply to charged particles in crossed, uniform, electric and magnetic fields. A.

537.534.74 : 539.152.1

2553. On the scattering of protons in hydrogen. CRITCHFIELD, C. L. AND DODDER, D. C. *Phys. Rev.*, **75**, 419–25 (*Feb.* 1, 1949).—Results of recent proton-proton scattering experiments [Abstr. 1072 (1949)] are used to calculate phase shifts for the interaction. *S*-wave scattering is found which agrees with previous work in corresponding to the potential of an attractive rectangular well of radius e^2/mc^2 and depth 10·5 MeV, or to a Yukawa-type potential with a meson of mass in the neighbourhood of 300 electron masses. An anomaly which remains at the smaller angles is not removed by a careful treatment of the geometry of the scattering chamber, but is tentatively accounted for with a combination of repulsive *p*-wave scattering and a systematic experimental error of approximately 1%. The *p*-wave phase shifts are several times $>$ those expected from a repulsive rectangular well of the same dimensions as the well for the *s*-wave scattering. A.

537.534.74 : 539.17

2554. The penetration of atomic particles through matter. BOHR, N. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **18** (*No.* 8) 144 *pp.* (1948) *In English.*—A comprehensive treatment, including fission particles as well as lighter particles, with emphasis on points illustrating general principles. Other points are treated qualitatively, with mathematical details omitted if they are discussed elsewhere. There are 5 sections. (*a*) Scattering of charged particles in atomic fields, especially the conditions of validity of simplified treatments. (*b*) Penetration phenomena depending on nuclear collisions, including stopping power and multiple scattering. (*c*) Atomic excitation and ionization for fast electrons ($v > e^2/\hbar$). (*d*) Capture and loss of electrons by ions in atomic collisions, including the balance between the two effects. (*e*) Range-velocity relations for high-speed light nuclei, fast heavy ions and slow ions. G. J. K.

537.534.74 : 539.172

2555. The angular distribution of 1 to 3·5 Mev deuterons scattered by deuterons. BLAIR, J. M., FREIER, G., LAMPI, E., SLEATOR, W., JR. AND WILLIAMS, J. H. *Phys. Rev.*, **74**, 1594–8 (*Dec.* 1, 1949).—The differential cross-section for the elastic scattering of deuterons by deuterons has been obtained in the energy range from 1 to 3·5 MeV. The observed yields were corrected for the counted particles produced in the D – D reactions and for those scattered by contaminants by using the results of other experiments. The resultant elastic cross-sections are probably accurate to about 2·5%. A.

537.534.74 : 539.185

Neutron-proton scattering at 90 Mev. *See Abstr.* 2747

537.534.8

2556. Note on the bremsstrahlung produced by protons. POWELL, J. L. *Phys. Rev.*, **75**, 32–3 (*Jan.* 1, 1949).—A discussion assuming that the anomalous magnetic moment can be described in terms of a Pauli type interaction with the electromagnetic field. The result of a perturbation theoretical calculation of the cross-section is given, and a comparison is made to the approximate method of Weizsäcker and Williams. Reasons are given for the failure of the Weizsäcker method in special cases. A.

DISCHARGE TUBES . COUNTERS 537.54

537.54

2557. Properties of the α-particle spark counter. CONNOR, R. D. Letter in *Nature, Lond.*, **163**, 540–1 (*April* 2, 1949)—Describes expts. with various forms of Rosenblum counter [see Abstr. 1942 (1945)] and with various gases (air, oxygen and argon/air). Plateau characteristics for the "end-on" and "broad-side" positions are given. J. D. C.

537.54

2558. Luminescent counters. KALLMANN, H. *Research, Lond.*, **2**, 62–8 (*Feb.*, 1949).—The author surveys the properties of 11 inorganic and 3 organic substances as scintillation counters for α-particles, γ-rays and soft X-rays. Consideration is given to the choice of substances most sensitive to a small flux of radiation, and those most suited to the detection of individual quanta because of the short duration of the emitted light pulses. Applications of the counters to the measurement of α-particle energy, the detection of fission products and the measurement of neutrons are described. L. E. M.

537.54 : 519.21

2559. The statistical theory of the dead time losses of a counter. CLARK, C. E. *Rev. Sci. Instrum.*, **20**, 51–2 (*Jan.*, 1949).—In the case of events at random times, the number of events must be estimated from the number of counts recorded by a counter. The statistical distribution of the unknown number of events is studied and is shown to be approximately normal. The standard deviation is approximated. A.

537.54 : 539.166

The detection of gamma-rays with sodium-iodide crystals. *See Abstr.* 2690

537.54 : 621.318.572

2560. A double-channel, direct reading, low frequency counting rate meter and counting rate comparator. KLOEPPER, R. M. AND HOECKER, F. E. *Rev. Sci. Instrum.*, **20**, 17–26 (*Jan.*, 1949).—A two-channel, direct-reading counting rate meter for measurement of l.f. (average random or uniform) pulse rates in either channel or in both channels simultaneously is described. The outputs of two degenerative vacuum-tube voltmeter integrating circuits are combined in a bridge circuit whereby the equality of pulse rates in the two channels may be determined on a null-reading galvanometer. An impulse register amplifier is provided on each channel for operation of impulse counters for monitoring and/or calibration. The 5 ranges provided are 0–100, 200, 500, 1 000 and 5 000 pulses/min. Although primarily designed for the specific purpose of adjusting two atmospheric-pressure wire/plate α-particle detectors [see Abstr. 1942 (1945)] to equal average pulse rates, the circuit design may be modified to detect pulse-rate ratios other than unity, pulse-rate differences, and/or pulse-rate ranges other than those enumerated above. A.

537.54 : 621.318.572

2561. An improved quench circuit for Geiger counters. COOKE-YARBOROUGH, E. H., FLORIDA, C. D. AND DAVEY, C. N. *J. Sci. Instrum. Phys. Ind.*, **26**, 124–5 (*April*, 1949).—A quench circuit is described to improve the characteristics of Geiger counters containing a quenching vapour—mainly in respect of greater sensitivity to small pulses, better constancy of dead time and better stability. This improvement is effected, first, by suppressing spurious counts, thereby giving a flatter plateau, and, secondly, by providing a known constant dead time, thus permitting an accurate estimate of the counting losses to be made. A.

537.542

2562. Methylene bromide as a quenching agent in Geiger–Müller counters. CARVER, J. H. AND WHITE, G. K. Letter in *Nature, Lond.*, **163**, 526–7 (*April* 2, 1949).—The comparison of certain counters containing argon/ethyl alcohol and argon/methylene bromide showed the latter to be much less efficient than the former. Analysis showed that the difference could be attributed to negative ion formation in the methylene bromide. J. D. C.

537.542

2563. Quantitative measurements with scintillation counters. KALLMANN, H. *Phys. Rev.*, **75**, 623–6 (*Feb.* 15, 1949).—The efficiency of a number of fluorescent materials used as scintillation counters for various materials has been measured. Two characteristics have been distinguished: (*a*) The physical light yield, i.e., the fraction of the absorbed energy transformed into light, and (*b*) the practical light yield, i.e., the amount of light obtained from a given intensity of radiation of a particular type, with the thickness of the phosphor adjusted for optimum results. Although the sulphide phosphors are high in physical yield, their practical yield is relatively lower because they are quite opaque to their fluorescent radiations. The organic phosphors, such as naphthalene and phenanthrene, and the KBr phosphors are very much better in this respect. A.

537.542 : 539.16.08 : 531.791

2564. A Geiger–Mueller counting unit and external quenching equipment for the estimation of C^{14} in carbon dioxide. MANN, W. B. AND PARKINSON, G. B. *Rev. Sci. Instrum.*, **20**, 41–7 (*Jan.*, 1949).—A counter unit and external quenching circuit for use with CO_2 and CS_2 mixtures are described. The unit consists of a long and short counter to eliminate end effects. The quenching circuit, which depends on the action of a multivibrator, enables the voltage across the counter to be reduced in a controllable manner by any desired amount and for any desired time. A.

537.542 : 541.14

2565. Radiation chemistry of the Geiger–Mueller counter discharge. WEISZ, P. B. *J. Phys. Coll. Chem.*, **52**, 578–85 (*March*, 1948).—A survey is given of the self-quenching mechanism of the G.M. counter discharge. The radiation-chemical consequences discussed include the kinetics of ion neutralization on metal surfaces, the mobility of polyatomic ions through gases, and the kinetics of the dissociation products of the discharge process. R. W. P.

IONIZATION . THERMIONICS 537.56/.58

537.56 : 537.531

2566. Thimble-chamber calibration on soft X-rays. DAY, F. H. *J. Res. Nat. Bur. Stand., Wash.*, **41**,

295–301 (*March*, 1949).—Condenser *r*-meter thimble-chambers of various types have been calibrated against a standard free-air ionization chamber to indicate the wavelength dependance of their readings after exposure to 10–200 kV X-rays. X-ray tubes with low inherent filtration are used. Calibrations are conducted for minimum-filter conditions, and the effect of added filtration on the calibrations is noted. A chamber that reads correctly for filtered radiation of 100 kV quality may be in error by a factor of 2·3 for 10 kV X-rays. A.

537.56 : 537.533.92 : 539.181

2567. Ionization of the molecules KI, NaI, and CsCl by electrons. IONOV, N. I. *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 3) 467–9 (1948) *In Russian*.—The ionizing electron beam was directed at right angles to the molecular beam, and parallel to the magnetic field applied. After ionization, the molecular beam was spread out and its ions accelerated to 1 350 V before entering the magnetic mass-spectrometer. The constancy and relative density of the molecular beam could be maintained within ±1%. The ionization potential of H_2O^+ was taken as 13·0 V as a standard for calibrating the instrument. The tabulated results include a column in which the probable mechanism of ionization of the individual ion types formed is indicated, as well as the relative intensity of the individual mass lines measured at 60 V electron energy. The observed ionization processes are all of an elementary character, and no secondary effects could be detected. B. F. K.

537.56 : 530.12

2568. On the ionization produced by a particle with spin in the relativistic limit. THIBAUD, J. *C.R. Acad. Sci., Paris*, **228**, 171–3 (*Jan.* 10, 1949) *In French*.—General arguments are given for the small ionization of a light particle with a velocity approaching that of light, passing through matter. G. J. K.

537.562 : 537.58

2569. Ionization processes on tungsten filaments. I. The electron affinity of the oxygen atom. METLAY, M. AND KIMBALL, G. E. *J. Chem. Phys.*, **16**, 774–8 (*Aug.*, 1948).—The affinity was determined to be 53·8 ± 0·8 kcal./mole by measuring the ratio of ions to electrons leaving a hot W filament in contact with N_2O gas at a low pressure. Previous investigations of this quantity yielded discordant results. A possible reason for this disagreement is set forth. A.

537.562 : 541.183.02

Absorption of fluorine on tungsten. *See Abstr.* 2787

537.568

2570. Spontaneous dissociation of ions. HIPPLE, J. A. *J. Phys. Coll. Chem.*, **52**, 456–62 (*March*, 1948).—The dissociation of molecular ions during transit through mass spectrometers is discussed. Early work in this field is reviewed and interpreted in relation to recent experiments. C. B. A.

COSMIC RAYS 537.591

537.591

2571. The effective path length through a vertical cosmic-ray telescope. WITMER, E. E. AND POMERANTZ, M. A. *J. Franklin Inst.*, **246**, 293–309 (*Oct.*, 1948).—The effective path length of cosmic-ray particles through a vertical counter telescope as a function of telescope geometry and of the zenith angle variation of intensity of the particle groups concerned is set out in a series of graphs. J. G. W.

537.591

2572. The cosmic-ray intensity above the atmosphere. GANGNES, A. V., JENKINS, J. F., JR. AND VAN ALLEN, J. A. *Phys. Rev.*, **75**, 57–69 (*Jan.* 1, 1949).—In a series of flights of Aerobee and V-2 rockets at geomagnetic latitude $\lambda = 41°$N, single Geiger counters and Geiger counter telescopes have been employed to measure the total intensity of cosmic rays above the appreciable atmosphere. The directional intensity averaged over the upper hemisphere is found to be 0·120 ± 0·009 sec/cm²/steradian, constant from 55 km altitude to the highest altitude reached of 161 km. This result is an experimental upper limit to the primary intensity of charged particles at this latitude. A.

537.591

2573. The properties of cosmic radiation at very high altitudes. POMERANTZ, M. A. *Phys. Rev.*, **75**, 69–80 (*Jan.* 1, 1949).—The variation of the vertical cosmic-ray intensity as a function of altitude has been investigated in a series of free-balloon ascents with standardized quadruple-coincidence-counter trains containing various amounts of interposed absorber, to a max. thickness of 7·5 cm Pb. The curves thus obtained converge at the "top of the atmosphere." A max. occurs in the curve with 4 cm of Pb, but disappears with 6 cm of Pb. Cosmic-ray absorption curves at various altitudes above that corresponding to an atmospheric pressure of 250 mm of Hg are plotted from the data, as are integral and differential distributions-in-range. The relative stopping powers of C and Pb are also available from the data. Disturbing effects such as those arising from side showers and scattering appear to be negligible. An extrapolation procedure, which leads to results consistent with those of other experiments, provides a new picture of the composition of the cosmic rays in the atmosphere. With heavier particles ($P + M$) displaying a max. intensity at a higher altitude than electrons (E), the conclusions drawn from the present investigation are compatible with a primary radiation consisting of protons (and possibly heavier nuclear particles) producing mesotrons which subsequently give rise to the electronic component. Comparison of the results reported here with those of Schein and Allen indicate an absorption of primaries, by a process other than ionization, in thicknesses of Pb between 7·5 and 18 cm. A.

537.591.08

2574. Apparatus for cloud-chamber investigations with free balloons. LOFGREN, E. J., NEY, E. P. AND OPPENHEIMER, F. *Rev. Sci. Instrum.*, **20**, 48–51 (*Jan.*, 1949).—Apparatus for taking cloud-chamber pictures in free balloon flights is described. The 12 in cloud chamber is photographed once per minute by stereo cameras. The complete equipment for a 6 hr operation at 90 000 to 100 000 ft weighs 65 lb and is housed in a 30 in diameter gondola equipped with temperature control. A.

537.591.1

2575. On the soft component of cosmic rays. TRUMPY, B. *Bergens Mus. Arb.*, **2** (*No.* 4) (1946–47) *In English.*—An anticoincidence method was used to measure the barometer effect and zenith angle variation of the soft component of cosmic rays. The barometer effect of the soft component at the vertical but not at other zenith angles was considerably greater than that of the hard component. The ratio of soft/hard components increased with zenith angle, while detailed absorption measurements gave indication of a variation of quality of soft component as zenith angle is altered. J. G. W.

537.591.1

2576. On π and μ mesons in the penetrating component of cosmic rays. PEYROU, C. AND LAGARRIGUE, A. *C.R. Acad. Sci., Paris*, **228**, 312–14 (*Jan.* 24, 1949) *In French.*—A cloud chamber is used to measure the momentum of particles of which the range is determined by Pb screens and counter layers below the chamber, while differing parts of the incident spectrum are selected by a thick Pb absorber over the apparatus. At 1 000 m altitude, 33% of the particles measured under 72 cm Pb were identified as π mesons, under 24 cm Pb, 17·5%. J. G. W.

537.591.1

2577. V-2 cloud-chamber observations of a multiply charged primary cosmic ray. GOLIAN, S. E., JOHNSON, C. Y., KRAUSE, E. H., KUDER, M. L., PERLOW, G. J. AND SCHROEDER, C. A. Letter in *Phys. Rev.*, **75**, 524–5 (*Feb.* 1, 1949).—In a cloud chamber operating in a (free falling) V-2 rocket certain sources of track distortion are eliminated, but cleaning in subsidiary expansions fails since drops do not fall in the chamber. A photograph at 145 km altitude shows a heavily ionizing particle which traverses two 1 cm Pb plates in the chamber, and is shown to be probably of higher charge than a proton. J. G. W.

537.591.1

2578. The primary soft component of cosmic radiation. JÁNOSSY, L., ROSSI, B. AND HULSIZER, R. I. Letter in *Nature, Lond.*, **163**, 246–7 (*Feb.* 12, 1949).—The interpretation of an experiment of Hulsizer and Rossi [Abstr. 3816 (1948)] that $\gtrsim$ 1% of primary cosmic rays can be electrons is criticized, and the experiments are held to give no significant upper limit to the proportion of electrons in the primary cosmic rays. Replying, Hulsizer and Rossi agree that their result was too low, and consider the upper limit of primary electrons ~11%. No decisive evidence on the existence of primary electrons is yet available. J. G. W.

537.591.1

2579. On the origin of cosmic rays. ALFVÉN, H., RICHTMYER, R. D. AND TELLER, E. Letter in *Phys. Rev.*, **75**, 892–3 (*March* 1, 1949).—The difficulty of finding a highly efficient generation process for cosmic rays spread uniformly throughout the galaxy is avoided by assuming that they are generated in the neighbourhood of the sun, and homogenized by extended magnetic fields. Absence of electrons can be explained by Compton scattering in the sun's radiation field. Variations of cosmic-ray intensity during magnetic storms implies polarization of the incident solar corpuscular beams, which it is suggested is produced by the passage of the beams through the sun's magnetic field. Cosmic rays would then be produced by the acceleration of particles repeatedly passing through such beams. M. W. O.

537.591.1

2580. A cosmic ray particle of charge two or greater. SAFFORD, R. W. AND THORNDYKE, A. M. Letter in *Phys. Rev.*, **75**, 903–4 (*March* 1, 1949).—A heavily ionizing particle photographed in a cloud chamber at 93 000 ft altitude penetrates a 16 gm/cm² Pb plate and is shown to be an α-particle or heavier particle. J. G. W.

537.591.1 : 539.18

2581. The mass of the cosmic-ray mesotrons. BRODE, R. B. Letter in *Phys. Rev.*, **75**, 904–5 (*March* 1, 1949).—The reduction of range momentum data for mesons assumed to be of unique mass under the conditions that the uncertainty both of range and momentum are substantially independent of the actual values of range and momentum is considered. Data previously reported by Fretter [Abstr. 902 (1947)] are shown to yield a mass value $(212 \pm 5)m_0$. J. G. W.

537.591.15

2582. Cosmic-ray bursts at sea level and under thirty meters of clay. CHOU, C.-N. *Phys. Rev.*, **74**, 1659–66 (*Dec.* 1, 1948).—Cosmic-ray bursts have been investigated by means of ionization chambers made of duralumin, of volume 1·15 litre and wall thickness 12 mm, filled with A to pressures of about 82 atmos. at 0°C. The bursts were registered with recording electrometers. The experiments were carried out in a hut with a thin roof at sea level and in an underground station under 30 m of clay. At both levels runs were made with the chambers unshielded and also with sheets of Al (up to 33 cm) and of Pb (up to 18 cm) placed above them. In all, about 3 000 hr at the underground station and 1 000 hr at sea level were successfully recorded. The results obtained underground are the first systematic investigation concerning bursts observed far below sea level. The air-lead transition curves there show a flat maximum which occurs at a greater thickness of Pb than that observed at sea level. A.

537.591.15

2583. Studies of bursts at sea level. CARMICHAEL, H. *Phys. Rev.*, **74**, 1667–88 (*Dec.* 1, 1948).—Data obtained in some 2 000 hr of photographic registration of cosmic-ray ionization bursts at sea level are reported. The measurements cover a very wide range of burst size (factor 2 000) in two ion chambers of volumes 175 and 1·1 litres, with A, N, and H fillings at pressures ranging from 1·5 to 87 atmos. When the ion chambers (thin-walled) are unshielded the bursts are very clearly separable into a component resulting from the extensive cascade showers from the atmosphere and a component resulting from heavily ionizing particles from cosmic-ray induced nuclear disintegrations. The number-size distributions to be expected in the ion chambers from single protons and α-particles produced by nuclear disintegrations are calculated on the assumption that

these particles have the energy spectrum given by Bagge. The effect of columnar recombination at high pressures in N and A is discussed and allowed for. The agreement obtained between the calculated curves and those observed shows that the interpretation of this component as chiefly caused by single heavily ionizing protons and α-particles is probably correct. Some very rare bursts of anomalously large size are found under moderate thicknesses of lead. The experimental results of others are reviewed, and detailed comparisons are made. A.

537.591.15

2584. The structure of the large cosmic-ray air showers. WILLIAMS, R. W. *Phys. Rev.*, **74**, 1689–706 (*Dec.* 1, 1948).—A series of experiments on cosmic-ray air showers is described. 4 "fast" ionization chambers, with electronic coincidence and photographic recording of pulse height, were used to investigate the structure of these showers in detail, at mountain altitudes. The experiments show that the showers have the structure characteristic of electron cascades. There is no evidence for unusually narrow showers. If the showers originate from the decay of neutral mesons, these mesons must be produced either singly, or in groups whose total angular divergence is not greater than $\sim 10^{-4}$ radian. The frequency of occurrence of showers which have particle density greater than ρ-particles per square metre at the point of observation is shown to be $1{\cdot}05(460/\rho)^{1{\cdot}5}$ hr^{-1}, $300 < \rho < 2\,000$ particles/m^2, at 3 050 m elevation. This frequency is also given for 2 points of observation with various distances separating them. Data on the angular distribution of the showers at 3 050 m and the altitude variation between 3 050 m and 4 300 m are presented. The results of some theoretical calculations on altitude and angular variation are given, but they are not sufficiently accurate to indicate clearly the nature of the primary event which causes these showers. Absolute rates for the number of showers of a certain size, and for the number of primary events, are presented. 27 showers of more than 10^{16} eV total energy were recorded. A.

537.591.15

2585. Investigation of narrow showers at an altitude of 3 250 m above sea-level. ALIKHANYAN, A. AND DADAYAN, A. *J. Exp. Theor. Phys., USSR*, **19**, 78–85 (*Jan.*, 1949) *In Russian.*—A method of particularly high resolving power is presented. The distribution in space of particles, their penetrating power and density in the showers was studied. It was also shown that the particles constituting the narrow showers form a fraction of about 8% of all charged particles observed at the height of 3 250 m above sea level. B. F. K.

537.591.15

2586. The absorption of particles in extensive cosmic ray showers. AUGER, P., DAUDIN, J., FREON, A. AND MAZE, R. *C.R. Acad. Sci., Paris*, **228**, 178–80 (*Jan.* 10, 1949) *In French.*—Attention is drawn to the distinction between measurements in which one counter group only of an extensive array is covered with a shield of varying thickness, and those in which all groups of the array are equally shielded. The absorption coefficient of the particles between 2 and 13 cm Pb is about 40 gm/cm^2. J. G. W.

537.591.15

2587. The angular and lateral spread of cosmic-ray showers. ROBERG, J. AND NORDHEIM, L. W. *Phys. Rev.*, **75**, 444–57 (*Feb.* 1, 1949).—The mean square angular and lateral spreads in showers have been evaluated for electrons as well as photons as functions of their energy. Analytical expressions have been obtained for high and medium energies down to the critical shower energy. The calculations have been extended by numerical methods for air down to low energies (~ 4 MeV). Radiative effects and ionization losses have been taken into account simultaneously for all energies, and it is believed that no factors of physical significance have been omitted. A.

537.591.15

2588. Absorption of penetrating shower primaries. TINLOT, J. AND GREGORY, B. Letter in *Phys. Rev.*, **75**, 519–20 (*Feb.* 1, 1949).—Absorption of ionizing particles producing penetrating showers was measured in Fe and Pb at 14 200 ft altitude in an apparatus designed to exclude all events in which the first interaction of particles entering the apparatus from the air takes place in the absorber under investigation, and which is therefore considered to measure essentially the collision mean free path. Within errors of experiment, exponential absorption in Pb and Fe is observed, with the respective m.f.p.'s 310 gm/cm^2, 200 gm/cm^2. J. G. W.

537.591.15

2589. Correlation of penetrating showers with air showers. TINLOT, J. AND GREGORY, B. Letter in *Phys. Rev.*, **75**, 520 (*Feb.* 1, 1949).—The association with atmospheric showers of penetrating events, rigidly selected so that one ionizing particle only emerged from the main absorbing layer and produced $\geqslant 2$ particles at a lower level, was examined, using unshielded counter arrays at distances 1 and 2·5 m from the penetrating shower detector. Association with the more distant unshielded array was at the level of random coincidences, association with the nearer tray (about 1% of penetrating events) was about 20 times as great. J. G. W.

537.591.15

2590. Mixed cosmic-ray showers at sea level. CHAO, C. Y. *Phys. Rev.*, **75**, 581–90 (*Feb.* 15, 1949).—A detailed analysis of 15 cloud-chamber photographs of mixed showers is given. This analysis gives the following results: (*a*) Mixed showers contain, in general, both slow and fast heavy particles in addition to the electron component. Some of the heavy particles can be identified as protons and some as mesons. (*b*) The electron component of the mixed showers consists sometimes of a single cascade shower and sometimes of several cascade showers. In cases where only a single cascade shower is present its axis is found to be within an angle of 2 or 3 degrees from the direction of the primary particle when this is observable. In cases where several cascade showers appear, one of them often propagates nearly in the direction of the primary particle when this is observable. (*c*) The simultaneous existence of several cascade showers with their axes diverging at fairly

large angles indicates that several high energy electrons or photons are produced in the shower origin. (*d*) In three cases, an electron group is produced below the shower origin by a non-ionizing particle which seems to originate from the primary nuclear event. These particles may be photons. (*e*) In one case, two successive nuclear events are observed, which are separated by approximately 60 g/cm² of Pb. (*f*) In one case, a star is produced by a penetrating shower particle after traversing approximately 30 g/cm² of Pb. A.

537.591.15

2591. Further experiments on cosmic-ray bursts. BRIDGE, H. S. AND ROSSI, B. *Phys. Rev.*, **75**, 810–18 (*March* 1, 1949).—Describes results obtained by the observation of coincidences between pulses of a G–M counter tray and of an ionization chamber. The experiments were carried out partly aboard a B-29 aircraft and partly on the top of Mt. Evans, Colorado. The main purpose of the experiments at Mt. Evans was an investigation of the "transition curve" in Pb. The experimental data are consistent with the assumption that the coincident bursts observed with a Pb shield between the G–M tubes and the ionization chamber are mainly produced by cascade showers initiated by electrons and photons either incident upon the Pb from the atmosphere or produced in the Pb by nuclear interactions. The experiments aboard the B-29 furnish information on the variation with altitude of the radiation responsible for the nuclear interactions. A.

537.591.15 : 539.18

2592. On the nature of mesons in penetrating showers. MEYER, H. A., SCHWACHHEIM, G., WATAGHIN, A. AND WATAGHIN, G. Letter in *Phys. Rev.*, **75**, 908–9 (*March* 1, 1949).—The absorption of penetrating showers initiated in the atmosphere and in a layer of gasoline, by a layer of 110 gm/cm² Pb is investigated. The showers from the gasoline layer are more absorbable; it is suggested that π mesons are initially formed but have decayed to μ mesons in air-initiated showers, so that the additional absorption of the gasoline showers arises from the nuclear interaction of π mesons. J. G. W.

537.591.2

2593. The energy spectrum of the photon component of cosmic radiation. CLAY, J. *Physica, 's Grav.*, **14**, 569–74 (*Jan.*, 1949) *In English.*—The formation of electron pairs and of Compton electrons by cosmic-ray photons in a thin Pb layer are distinguished, and the absorption coefficient for these photons determined in a further Pb layer above the detecting counter array. An energy spectrum of the photon component, related to the critical energy, is given. J. G. W.

537.591.5

2594. East-west asymmetry and latitude effect of cosmic rays at altitudes up to 33 000 feet. BARBER, W. C. *Phys. Rev.*, **75**, 590–9 (*Feb.* 15, 1949).—By means of triple coincidence telescopes mounted in a B-29 aeroplane, the E-W asymmetry of cosmic rays has been measured at several geomagnetic latitudes from 0 to 41 deg. N. The asymmetry was determined separately for the hard, soft, and shower-producing components of the radiation. At a zenith angle of 45 deg., the intensity of each of these components from the W direction exceeded that from the E direction by an amount which increased rapidly as the geomagnetic latitude was decreased. Comparison of the amount of asymmetry with the observed latitude effects permits the conclusion that all components arise from primary rays which in the range of energies explored by the experiment are all or nearly all positively charged. During the course of the experiments, vertical intensities of the hard and soft components were also measured. Data on the variation of the vertical intensities with altitude and with geomagnetic latitude are presented. A.

537.591.5 : 523.746

2595. Relation of the cosmic radiation to sunspot magnetic moments. BROXON, J. W. *Phys. Rev.*, **75**, 612–19 (*Feb.* 15, 1949).—A function (SS-MM) [see Abstr. 2296 (1949)] designed to represent the arithmetical sum of the magnetic moments of all visible sunspots has been compared statistically with the intensity of the cosmic radiation (C-R). Large pulses (20 to 30%) in SS-MM were found to occur out of phase with primary pulses in C-R. SS-MM pulses of comparable magnitude bore different phase relations to subsidiary pulses in C-R. For subsidiary pulses preceding the primaries, the C-R was generally high when the SS-MM was increasing and low when it was decreasing. For subsidiary pulses following the primaries, the C-R was generally high when the SS-MM was decreasing and low when it was increasing. The analysis was carried out for intervals of 60 days preceding and following the selected days of high or low C-R. Some consideration was given to the e.m.f. generated in connection with an imaginary but in some respects representative sunspot by electromagnetic induction. A.

537.591.8

2596. The production of true mesons in cosmic events observed by means of a sensitive emulsion. CÜER, P., MORAND, M. AND MOUCHARAFYEH, H. *C.R. Acad. Sci., Paris*, **226**, 2066–8 (*June* 21, 1948) *In French.*—From observations on large and small star disintegrations, and their frequency relative to each other and to slow meson production, it is concluded that multiple production of true mesons by a very fast incident nucleon striking a heavy nucleus is unlikely. One might be able to correlate the observations by supposing total excitation of the nucleus to be a likely process, following which meson production competes with star disintegration. A. P. F.

537.591.8 : 539.17

Origin of cosmic ray stars. *See Abstr.* 2709

537.591.8 : 539.185

2597. Neutron production by cosmic rays at sea level. TOBEY, A. R. Letter in *Phys. Rev.*, **75**, 894–5 (*March* 1, 1949).—A BF_3 counter was surrounded by a thickness of paraffin wax large enough to prevent appreciable recording of neutrons incident from outside, and the neutron production in paraffin measured. Similar measurements were also made with Al and Pb dispersed in the paraffin. Rates of neutron production at sea level were $\sim 2 \cdot 10^{-5}$/sec/gm in light material and $6 \cdot 10^{-5}$/sec/gm in Pb. J. G. W.

MAGNETISM 538

538.082 : 621.317.44

2598. A null deflection magnetometer with electromagnetic control. INGLES, A. R. *Amer. J. Phys.*, **16**, 391–7 (*Oct.*, 1948).—A centre-zero moving-coil instrument was converted to a magnetometer by the addition of a small magnet carried on an extension opposite the pointer, subsequently rebalanced. A mirror was mounted on the movement spindle which was supported with its axis vertical. In use, the force on the magnet is countered by a current through the instrument, adjusted to zero deflection. Experiments were made on the following:—force between a very short magnet and a short magnet placed on a common axis; force between a very small magnet and a single pole placed on the axis of the magnet; magnetization curves and hysteresis cycles; variation of the intensity of magnetization with temperature. Other possible experiments are briefly mentioned. E. H. W. B. (R)

538.11 : 537.122

Kinetics of the diamagnetism of free electrons. *See Abstr.* 2487

538.113 : 539.152.2 : 535.338.32

Erratum: Line shapes in nuclear paramagnetism. *See Abstr.* 2655

538.114

2599. Ferromagnetism. STONER, E. C. *Rep. Phys. Soc. Progr. Phys.*, **11**, 43–112 (1946–47).—Reviews theories of ferromagnetism from Weiss to Stoner and Mott. Domain hypothesis, crystal anisotropy, Becker's strain theory and the magnetocaloric effect are reviewed. Experimental checks of theories of intrinsic magnetization are discussed, and behaviour of ferromagnetic and paramagnetic alloys is reported. A deliberate omission is the work on "non-metallic" ferromagnetics. N. F. A.

538.114 : 539.31

2600. Irreversible magnetic effects of stress. BROWN, W. F., JR. *Phys. Rev.*, **75**, 147–54 (*Jan.* 1, 1949).—When Rayleigh's law for small hysteresis loops is interpreted in terms of the elementary process of domain wall displacement, its generalization to include effects of stress becomes possible. In this way theoretical formulae have been derived for the behaviour of a soft Fe or steel specimen which is first put into a state of normal magnetization at small magnetizing force H and is then subjected to a small tension cycle. According to the theory the magnetization should increase upon application of tension T by an amount $g(4{\cdot}00\times10^{-9}HT + 9{\cdot}86\times10^{-18}T^2)$ in c.g.s. e.m.u., where $4\pi g$ is the slope of the normal permeability v. H curve, and should remain at the new value upon removal of the tension. An experimental test of the theory verified these predictions within the precision claimed for them. On the basis of the theoretical model, certain effects of diminishing alternating fields and stresses are analysed quantitatively; the results are used to explain qualitatively the observed long-time magnetic behaviour of ships. A.

538.12 : 534.852 : 681.84 : 621.395.625.3

Magnetic field of a ring recording lead. *See Abstr.* 2408

538.12 : 537.533.3 : 621.385.132 : 621.317.42

2601. An electron tube for viewing magnetic fields. LUTZ, S. G. AND TETENBAUM, S. J. *Elect. Engng, N.Y.*, **67**, 1143–6 (*Dec.*, 1948).—A diode whose anode is perforated with many small holes is sealed into a large bulb. The tube is filled with Hg vapour. The electrons emerging from the anode holes ionize the vapour and in a magnetic field tend to follow the lines of force, so the tube can be used for the qualitative investigation of magnetic fields. A. H. W. B. (R)

538.12 : 550.38

2602. Periods of motion in periodic orbits in the equatorial plane of a magnetic dipole. JUÁREZ, A. R. *Phys. Rev.*, **75**, 137–9 (*Jan.* 1, 1949).—The differential equations of motion of an electrically charged particle in the equatorial plane of a magnetic dipole are solved to give the time for periodic orbits. For electrons moving in the equatorial plane of the magnetic field of the earth, the periods in seconds have been determined. A.

538.2

2603. Ferromagnetism at very high frequencies. II. Method of measurement and processes of magnetization. JOHNSON, M. H. AND RADO, G. T. *Phys. Rev.*, **75**, 841–64 (*March* 1, 1949).—A method for measuring the complex permeability, μ, of a ferromagnetic metal is described. The determination of both components of μ is accomplished by a simultaneous measurement of the changes in attenuation and phase velocity introduced into a conducting system by the ferromagnetism of one of its walls. An experimental technique involving pulsed magnetic fields is used. Values of μ for samples of magnetic Fe at 200 and 975 Mc/s as a function of a polarizing magnetic field (which is parallel to the high frequency field) are compared to the static incremental permeabilities measured on the same sample. The interpretation of the experimental results indicates several characteristics of the magnetization in Fe: the upper limit of domain dimensions in polarizing fields < 500 oersteds is 10^{-4} cm; domains have different degrees of stability in the applied field; "weak-field domain" wall displacements are practically eliminated at the frequencies used; spin rotation and "strong-field domain" wall displacements are only slightly damped and contribute to the magnetization in weak as well as strong fields. Studies of hysteresis phenomena are discussed, and results on two types of permalloy presented. A.

538.22 : 541.67

Magnetic susceptibilities of some U^{+4} compounds. *See Abstr.* 2790

538.22 : 541.67 : 539.133

Diamagnetic susceptibilities of shared electrons. *See Abstr.* 2791

538.22 : 548

2604. The magnetic properties of α Fe_2O_3. NÉEL, L. *C.R. Acad. Sci., Paris*, **228**, 64–6 (*Jan.* 3, 1949) *In French.*—The observed magnetic properties of α Fe_2O_3 are explained by supposing the presence of thin plates of Fe_3O_4 whose 111 planes share an oxygen layer with the 0001 planes of the α Fe_2O_3. The observed antiferromagnetism is due to the

oppositely magnetized layers of iron in the α Fe_2O_3 and the ferromagnetism to the Fe_3O_4. A. E. DE B.

538.221

2605. The variation with temperature of the magnetization of nickel. JELLINGHAUS, W. AND SCHLECHTWEG, H. *Ann. Phys., Lpz.* (*Folge* 6) **2** (*Nos* 3–4) 161–77 (1948) *In German.*—The validity of the Weiss–Langevin law of the variation of magnetization with temperature is tested by comparison with Weiss and Forrer's measurements on Ni [see Abstr. 1463 (1926)]. 3 different methods of computing the coefficient, W, of the Weiss molecular field from observed variations of J with H and T give inconsistent results. Attempts to fit the law to the experimental data are made by assuming that (1) the atomic magnetic moment varies with T, or (2) W varies with T and J. (1) leads to results which are not physically interpretable, and (2) fails to provide a law of variation which is consistent both with the experimental results and the Weiss law. It is concluded that no theoretical account of the experimental facts, which is free from self-contradiction, is obtainable by these means. C. E. W.

538.221

2606. On a new proof of spontaneous magnetization above the Curie temperature. FRAUNBERGER, F. *Ann. Phys., Lpz.* (*Folge* 6) **2** (*Nos* 3–4) 178–82 (1948) *In German.*—Observations on the permeability of Ni at high frequencies (20 Mc/s) show that the permeability decreases to unity and therefore the spontaneous magnetization disappears—at a temperature 50–100° above the Curie point. This is in agreement with observations on other physical properties which are influenced by spontaneous magnetization. A. E. DE B.

538.222 : 536.48

2607. Paramagnetism of single crystals of the salts of the iron group of elements at low temperatures. III. Six co-ordinated ionic salts of Cu^{++} and Fe^{++} ions. BOSE, A. *Indian J. Phys.*, **22**, 483–96 (*Nov.*, 1948).—The reciprocally related D-state ions Cu^{++} and Fe^{++} are discussed. The Stark-pattern of such states, under a predominantly cubic crystalline field with a feeble rhombic component, consists of a doublet and a triplet. For 6-co-ordinated Cu^{++} salts the doublet lies lowest, whereas the pattern is inverted for similar iron salts. Experimentally, the result of this inversion from Cu^{++} to Fe^{++} is not obvious, since both show large anisotropies and deviations of the effective moments from the spin-only value. An explanation is given of the observed behaviour of Cu^{++} and Fe^{++} salts, namely, that in the former the orbital contribution is confined to a single direction in the crystal and in the latter these act against the spin in some of the directions and for the spin in others. For the Cu^{++} salts from known X-ray data for the crystals a correlation is given between the ionic and the crystalline moments. The variation with temperature of the angle between the different ionic groups is calculated and an explanation for the change in the orientation of the magnetic axes of the crystal is given on this basis. From these studies, it is plausible to ascribe not only the cubic but also the small rhombic part of the field to the charged particles in the immediate neighbourhood of the paramagnetic ion. It is also concluded that the disposition of charged atoms about the paramagnetic ion and hence the crystalline field symmetry for a particular ion is largely decided by the degeneracy of the ion itself. The temperature variations of the moments of the Fe^{++} ion have an apparent similarity to the Co^{++} ions but unlike cobalt all the principal moments tend to spin-only value at high temperatures, showing the relative unimportance of high frequency contributions in Fe^{++}. A.

538.222 : 539.153 : 538.569.3

2608. Paramagnetic resonance absorption in chrome alum. HALLIDAY, D. AND WHEATLEY, J. *Phys. Rev.*, **74**, 1712–13 (*Dec.* 1, 1948).—Measurements have been made of relative values of the imaginary part of the high frequency susceptibility of both the ammonium and K salts of chrome alum at room temperature and of the K salt at 90°K. The value of the ground state splitting for each of the salts was then calculated using Weiss' theory. A.

538.222 : 548.0

2609. The paramagnetic susceptibility of neodymium sulphate-octahydrate. VAN DEN HANDEL, J. *Physica, 's Grav.*, **14**, 618–22 (*Jan.*, 1949) *In English.*—Measurements made by Gorter and De Haas over a range of temps. [Abstr. 2121 (1932)] were not in accord with results obtained by other workers. A re-measurement of the susceptibility with 3 samples, one of which was taken from the sample used by Gorter and De Haas, gives values closely corresponding with those of the earlier experiments and the discrepancy is still observed. The difference found in the case of the salt used by Gorter and De Haas may be due to a deviation from the normal crystal structure, too small to affect the X-ray pattern which showed no difference between the 3 samples. G. F. H.

538.224

2610. Magnetic susceptibility of zinc at liquid helium temperatures. SYDORIAK, S. G. AND ROBINSON, J. E. *Phys. Rev.*, **75**, 118–31 (*Jan.* 1, 1949).—The de Haas–van Alphen effect in Zn has been investigated at 4·2°K by measuring the couple on a Zn crystal in a uniform magnetic field. The data obtained give the dependence of the susceptibility both on field strength and on orientation of the crystal relative to the direction of the field. The susceptibility is found to be isotropic in the main cleavage plane. The experimental results are compared to the theory of Blackman and Landau, with which their main features are in qualitative agreement. Detailed examination, however, indicates discrepancies in (*a*) the phase of the periodicity, and (*b*) the shape and amplitude of the envelope of the oscillations, in that the theoretical envelope as interpreted from the data at low fields decreases too slowly at high fields. From the comparison it is estimated that the electrons responsible for the effect have a chemical potential $E_0 = 0{\cdot}02$ electron volts, a transverse effective mass $m_1 = 0{\cdot}01\ m_0$ (where m_0 is the free electron mass), and a ratio of transverse mass to longitudinal mass $m_1/m_3 = 0{\cdot}01$. From these values, the specific heat of these electrons is estimated to be 0·1% of the measured electronic heat, and their number to be

2×10^{-6} per atom. Comparison of these results with the work of Marcus on Zn and Shoenberg on Bi has also been made. A.

538.224

2611. The magnetic susceptibility of BeO. Hutchison, C. A., Jr. *Phys. Rev.*, **75**, 465–6 (*Feb.* 1, 1949).—The molal magnetic susceptibility of pure BeO is found to be $-11\cdot93\times10^{-6}$ (c.g.s. units) at 24·8°C. A.

538.23

2612. Calculation of the coercive field according to the theories of Becker and Kersten. Néel, L. *C.R. Acad. Sci., Paris*, **223**, 141–2 (*July* 17, 1946) *In French.*—The theory attributes hysteresis and the coercive field to local variations in the surface tension of the walls separating the elementary regions. Approx. expressions for the force are given both for plane and deformed walls. These give values < the experimental values. L. S. G.

538.23

2613. Apparent anomalies on the d.c. hysteresis loop of a ring specimen. Kayser, H. Letter in *J. Sci. Instrum. Phys. Ind.*, **26**, 60–1 (*Feb.*, 1949).—Suggests that intersection of magnetization curve and hysteresis loop observed on closed ring specimens is due to demagnetizing fields arising from non-uniformity of the magnetic circuit, for which anisotropy and the shielding effect may be responsible. N. F. A.

538.245

2614. Initial magnetization and coercive field of a single crystal of cobalt, along the easy and difficult axes of magnetization. Guillaud, C. and Bertrand, R. *C.R. Acad. Sci., Paris*, **227**, 47–8 (*July* 5, 1948) *In French.*—An astatic magnetometer was used to determine the initial magnetization and coercive force of a single crystal of Co along the easy and difficult axes of magnetization. The results are best represented by Rayleigh's law, $J = aH + bH^2$ for both directions of magnetization. Values of a, b, and the coercive force at 20°C and −196°C are given. In the case of the difficult direction the anisotropy constant K_1 is found to be $5\cdot0\,.\,10^6$ at 20°C and $7\cdot5\,.\,10^6$ at −196°C: the spontaneous magnetization at both these temps. is given as 1 410. H. P. M.

538.245 : 538.114

2615. Magnetic domain patterns on single crystals of silicon iron. Williams, H. J., Bozorth, R. M. and Shockley, W. *Phys. Rev.*, **75**, 155–78 (*Jan.* 1, 1949).—Magnetic powder patterns have been obtained on electrolytically polished surfaces of single crystals of Fe containing 3·8% Si by weight. Domains are easily visible, outlined by accumulations of colloidal magnetic particles. Several techniques have been developed that enable the direction of magnetization in each domain to be determined. Many types of domain patterns are observed, depending on the orientation of the surface with respect to the crystal axes. The simpler patterns can now be interpreted in some detail, and support the idea that the internal domain structure is relatively simple and is usually composed of a series of plates or slabs magnetized at 45° or 90° to the plate length. In one case it is verified that the plate thickness depends on plate length in approximate accordance with theory; and, for the more complicated "tree" patterns, comparison of theory with experiment shows that good agreement can be obtained using theoretical values of the wall energy. Further verification of the theory of Bloch walls is obtained by determining from experiment the change in spin orientation on traversing the wall. A.

538.245 : 538.114

2616. A simple domain structure in an iron crystal showing a direct correlation with the magnetization. Williams, H. J. and Shockley, W. *Phys. Rev.*, **75**, 178–83 (*Jan.* 1, 1949).—A hollow rectangle cut from a single crystal of 3·8% silicon Fe has been studied with the aid of powder patterns and flux measurements. The edges and surfaces were all cut accurately parallel to ⟨100⟩, the directions of easy magnetization. The domain pattern consists of 8 domains, 4 forming an inner rectangle magnetized in one direction and the others forming an oppositely magnetized outer rectangle. Changes in magnetization occur by the growth of one set of domains at the expense of the other. In the saturated condition, each leg of the rectangle is one domain about $1\cdot5\times0\cdot1\times0\cdot1$ cm in size. Implications of these results in connection with the Barkhausen effect are discussed, and a method of measuring the energy of the Bloch wall is proposed. A.

538.245 : 539.185

2617. On a proposal for determining the thickness of the transition layer between ferromagnetic domains by a neutron polarization experiment. Newton, R. R. and Kittel, C. *Phys. Rev.*, **74**, 1601–5 (*Dec.* 1, 1948).—The surface energy of the Bloch wall between ferromagnetic domains is of fundamental importance in domain theory; this energy can be computed if the wall thickness is known. It is proposed that this be measured by studying the polarization changes of a neutron beam which is passed through a single Bloch wall. The relation connecting wall thickness, neutron velocity, and polarization change is worked out; the required velocities are such that the experiment can probably be done with existing techniques, if grazing angles of incidence are used. A.

538.245 : 539.185

Magnetic refraction of neutrons at domain boundaries. *See Abstr.* 2748

ELECTROMAGNETISM
ELECTRODYNAMICS 538.3/.5

538.3

2618. Developments in series of the retarded quantities of classical electromagnetism. Durand, E. *J. Phys. Radium* (*Sér.* 8) **10**, 41–8 (*Feb.*, 1949) *In French.*—Field potentials and intensities for a moving charge are expressed in terms of non-retarded coordinates by means of Lagrange series. Corresponding expansions, in terms of the retarded time corresponding to a mean position of the charge, are obtained when the charge is confined to a limited region in space. R. A. N.

538.3 : 530.14

2619. Behaviour of a particle of very small mass in a magnetic field. Thibaud, J. Letter in *Nature, Lond.*, **162**, 329 (*Aug.* 28, 1948).—From uncertainty

relations it is shown that it may be possible to observe the magnetic moment of a particle of small mass moving at relativistic velocity, in contrast to the opposite conclusion valid at lower speeds. This conclusion is unchanged if the magnetic moment is not an invariant. G. J. K.

538.311

2620. The multipolar electromagnetic field. HUMBLET, J. *C.R. Acad. Sci., Paris*, **223**, 419–21 (*Sept.* 9, 1946) *In French.*—A system of electric charges is in motion in the interior of a sphere. Expressions are given for the electric and magnetic fields at an arbitrary point. These involve the electric and magnetic polar moments of various orders, and relations between these are given. L. S. G.

538.312

2621. The bilinear forms of the Maxwell field. VALATIN, J. G. *C.R. Acad. Sci., Paris*, **227**, 39–41 (*July* 5, 1948) *In French.*—Using an operator form of Maxwell's equations in a 6-dimensional space all the various invariants of the theory can be simply obtained as bilinear forms of $\Phi = (iE,H)$, also involving operators in the space. These invariants are listed. G. J. K.

538.561 : 621.396.611.4

2622. Radiation of cavity oscillations through a hole as analogue of the tunnel effect. KRASNUSHKIN, P. E. AND MUSTEL, E. R. *J. Tech. Phys., USSR*, **18** (*No.* 11) 1378–93 (1948) *In Russian.*—Investigation of the emission of electromagnetic waves set up in a cavity resonator connected with outer space by a neck. It is shown that the emission of the resonator may be treated as an analogue of the tunnel effect of quantum mechanics. Theory is confirmed by a series of experiments in the cm waveband. A.

538.566 : 621.392.26

2623. Theory of the propagation of an electromagnetic field in a dielectric rod of circular section. ABELE, M. *Nuovo Cim.*, **5**, 274–84 (*Aug.*, 1948) *In Italian.*—Properties of the field are studied in the case $\varepsilon_2\mu_2 > \varepsilon_1\mu_1$ where ε_2, μ_2 are the permittivity and permeability respectively of the rod, ε_1, μ_1 that of the surrounding medium. Two distinct modes exist, which degenerate into the usual *TE* and *TM* modes when there is axial symmetry of the field. In some cases there is a cut-off frequency below which propagation along the axis cannot exist. The theory of attenuation for an imperfect dielectric is studied. L. S. G.

538.566.3 : 621.396.11

2624. Polarization in the ionosphere (the so-called "Lorentz Term"). MALSCH, J. *Arch. elekt. Übertragung*, **2**, 231–7 (*June–July*, 1948) *In German.*—The theoretical work of Niessen [Abstr. 400 (1933)] on the absorption of electromagnetic waves in the Kennelly–Heaviside layer is extended and combined with some results deduced theoretically by Debye and Falkenhagen [Abstr. 2817 B (1928)] on relaxation forces and mobilities of ions in electrolytes. The results of the analysis are applied to the three principal regions of the ionosphere, and it is concluded that the Lorentz polarization correction is inapplicable to the ionosphere. W. J. G. B. (R)

MAGNETIC EFFECTS 538.6

538.63 : 537.312.

2625. Anomalous magneto-resistance effects in bismuth. CONN, G. K. T. AND DONOVAN, B. Letter in *Nature, Lond.*, **162**, 336 (*Aug.* 28, 1948).—The change of electrical resistance of Bi fibres with orientation of magnetic field has been studied. For a given orientation the resistance may be plotted against field strength, and some such curves show an anomalous effect in a certain range of field strength. A. E. DE B.

538.63 : 537.312.

2626. The electrical conductivity of bismuth fibres. I. Magneto resistance and the crystalline structure. DONOVAN, B. AND CONN, G. K. T. *Phil. Mag.*, **40**, 283–96 (*March*, 1949).—An experimental study of the change in conductivity in a magnetic field. The variation of resistance is studied as a function of orientation in the 2 main cases of the fibre axis parallel and perp. to the axis of rotation. In each case the axis of rotation is perp. to the magnetic field. The resistance changes are compared in detail with those obtained using a single crystal and this comparison gives much information about the crystalline state of the fibre. If the resistance is not too low the fibres approx. closely to single crystals with the main cleavage plane parallel to the fibre axis. For thicker fibres, having resistances < about 15 ohms/cm the chance of obtaining a single crystal is small, although there is much evidence of preferred orientations. A.

538.65 : 534.22 : 534.321.9

Suspected effect of magnetic fields on the velocity of ultrasonic waves. *See Abstr.* 2391

538.65 : 539.32

2627. A note on the ΔE effect in alnico. STREET, R. AND WOOLLEY, J. C. *Proc. Phys. Soc., Lond.*, **61**, 391–2 (*Oct.* 1, 1948).—A record of measurements of the change in Young's modulus as alnico is magnetized. For the method used see Abstr. 2165 (1948). The modulus increases steadily with the intensity of magnetization and the max. observed increase is 0·02%. L. S. G.

538.652

2628. Magnetostriction and order-disorder. GOLDMAN, J. E. AND SMOLUCHOWSKI, R. *Phys. Rev.*, **75**, 140–7 (*Jan.* 1, 1949).—An experimental and theoretical study of the relationship between saturation magnetostriction and the order-disorder transformation in an Fe–Co alloy has been carried out. For the experimental work alloys in the neighbourhood of the 50 atomic % composition containing 0·75% Cr were employed. Measurements of both electrical resistivity and neutron diffraction have been used to confirm the presence of the superlattice. Measurements of the magnetostriction were made with a resistance strain gauge technique. An increase in the saturation magnetostriction is observed on ordering. Theoretical analysis based on the influence of order on the fluctuation of local electron density predicts a variation in agreement with experiment and also accounts for the influence of composition. A.

538.652.08 : 621.317.44

2629. New techniques in measurement of magnetostriction. MICKELSEN, J. K. *Gen. Elect. Rev.*, **51**, 24–7 (*Nov.*, 1948).—An apparatus has been developed to measure magnetostriction strains with either a.c. or d.c. The test specimen is placed inside a coil so that its expansion produces displacement of one of two optical gratings and hence a reduction in the light falling on a photocell connected to a flux voltmeter. Results indicate that d.c. curves can be used at least for the lower frequencies to relate instantaneous values of magnetostriction and induction. Measurements of d.c. magnetostriction strain of $0{\cdot}05\times10^{-6}$ have been made using an electronic microammeter as detector. G. F. H. (R)

538.653.1

2630. Influence of the demagnetization by an alternating field on the galvano-elastic effect in nickel. ZAITSEV, V. I. *J. Exp. Theor. Phys., USSR*, **19**, 95–100 (*Jan.*, 1949) *In Russian.*—The influence is investigated of the magnetic texture produced by a preceding elastic distension and of the demagnetization in the elastically-distended state, on the character of the galvano-elastic effect in Ni. A strong influence of the demagnetization by an a.c. field on the galvano-elastic effect is revealed, and also the existence of a galvano-elastic hysteresis. B. F. K.

538.653.1

2631. Influence of an unstabilized magnetic texture on the hysteresis loop of the galvanomagnetic effect in nickel. ZAITSEV, V. I. *J. Exp. Theor. Phys., USSR*, **19**, 101–4 (*Jan.*, 1949) *In Russian.*—The influence is investigated of the magnetic texture established by a previous elastic distension or demagnetization in the elastically-distended state on the hysteresis loop of Thomson's galvanomagnetic effect. A possible explanation is offered for the anomalous character of the hysteresis loops of the even magnetic effects obtained by some authors. B. F. K.

538.662.13 : 621.318.2/.3 : 669.018.58

2632. Curie temperature alloys. SHAW, J. *Prod. Engng*, **19**, 158–63 (*June*, 1948).—By the addition of a non-magnetic element to a magnetic material it is possible to produce a material having any desired Curie temperature (C.t.) between 1 120°C and abs. zero. The C.t. of the material selected is important in 4 types of applications: (1) those requiring strong magnetic properties, e.g. generators, transformers, etc., the C.t. must be > highest temp. at which the device will operate; (2) a non-magnetic alloy may be required, as in c.r.t.s, transformer bushings, etc., here the C.t. must be the lowest operating temp.; (3) in the special expansion alloys as for glass-to-metal seals, it is desirable to pass through the C.t.; (4) where change in magnetic properties with temp. is utilized, the operating range of the device being slightly < the C.t. Design possibilities of the last application are considered in some detail. M.-V. (R)

MOLECULAR STRUCTURE 539.13

539.13 : 530.145

One-electron states of diatomic molecules. *See Abstr.* 2339

539.13 : 535.33

2633. Electronic states of organic molecules. SIMPSON, W. T. *J. Chem. Phys.*, **16**, 1124–36 (*Dec.*, 1948).—The spectra of 3 simple dye-like molecules, and of benzene and naphthalene, are treated in a semiquantitative fashion. The methods employed are the bond orbital, the molecular orbital (somewhat modified), the antisymmetrized molecular orbital, and two models, one related to the bond orbital, the other to the molecular orbital. The positions of main and second-order bands, and intensities, are calculated. Extension of the calculations to complex cases is indicated. A.

539.13 : 535.333

Microwave spectrum of carbonyl selenide. *See Abstr.* 2418

539.132 : 548.7

2634. Note on a relation between the order of a phase transition and discontinuities in the distribution functions of molecules. MAYER, J. E. *J. Chem. Phys.*, **16**, 665–8 (*July*, 1948).—It is pointed out that in a phase transition of order n the distribution functions for n molecules change discontinuously at the transition point. Application is made to second-order transitions in certain crystals. A.

539.132

2635. Symmetry matrices in normal coordinate analysis. KILPATRICK, J. E. *J. Chem. Phys.*, **16**, 749–57 (*Aug.*, 1948).—A symmetric matrix, U_n, is derived which may be used to combine n equivalent co-ordinates in a molecule having the symmetry of any cyclic or dihedral point group of multiplicity n. The direct products $U_2\times U_n$ and $U_2\times U_2\times U_n$ may be used in the cases of $2n$ and $4n$ equivalent co-ordinates. The symmetry type of each row of the symmetric matrices used is determined. A.

539.132

2636. A note on the theory of vibration-rotation interaction. LANGER, R. E. *Phys. Rev.*, **75**, 792–5 (*March* 1, 1949).—Attempts to treat the differential equation for the radial component of the *eigenfunctions* of a rotating harmonic oscillator by the W.K.B. or alternative methods, have encountered difficulties because of the nature of the equation. The interval from $r = 0$ to $r = \infty$, on which the equation has to be considered, includes both a singular point and a turning point. About these points the Stokes' phenomenon is involved, and the elementary asymptotic solutions fail to remain valid. Known theory which is applicable to the equation in intervals which contain such critical points is here called upon to yield an equation for the *eigenvalues*, and to produce descriptions of the solutions over the complete range of the variable. A.

539.132 : 534.321.9 : 532.74

Molecular structure of liquids from ultrasonic absorption. *See Abstr.* 2400

539.132 : 535.333–15

High frequency fundamental bands in the AsH_3 and AsD_3 spectrum. *See Abstr.* 2420

539.132 : 535.333–15

Infra-red bands in the spectrum of difluoromethane. *See Abstr.* 2421

539.132 : 535.343

Vibrational frequency assignments of paraffin hydrocarbons. *See Abstr.* 2427

539.132 : 535.343 : 535.375.5

Vibrational spectrum and thermodynamic functions of acrylonitrile. *See Abstr.* 2426

539.132 : 535.343.32

Theory of optical absorption in metal-amide solutions. *See Abstr.* 2431

539.132 : 535.375.5

Liquid *n*-butane and the normal modes of vibration. *See Abstr.* 2446

539.132 : 535.375.5

Molecular structure of diphenyl sulphide, diphenyl methane and sulphur monochloride. *See Abstr.* 2447

539.132 : 536.77

2637. The energy levels and thermodynamic functions of the fourth power oscillator. KILPATRICK, J. E. AND KILPATRICK, M. F. *J. Chem. Phys.*, **16**, 781–7 (*Aug.*, 1948).—The first six characteristic numbers of the reduced wave equation $\psi'' + (\lambda - \xi^4)\psi = 0$ were calculated by a method of numerical integration. These values have been compared with the corresponding values obtained from the first, second and third Wentzel–Kramers–Brillouin approximations. For the fourth, fifth and sixth characteristic numbers, the third W.K.B. approximation is correct with 0·0001. The four thermodynamic functions $-(F - H_0)/RT$, $(H - H_0)/RT$, S/R and C/R were calculated over the range $h\nu_0/kT = 0$ to 10. A previously reported maximum in the heat capacity function, C/R, does not exist. [See Abstr. 1534 (1945)]. A.

539.132 : 537.228.5 : 535.33

2638. The Stark effect for a rigid asymmetric rotor. GOLDEN, S. AND WILSON, E. B., JR. *J. Chem. Phys.*, **16**, 669–85 (*July*, 1948).—The Stark effect, arising from the interaction of a uniform electric field with a permanent electric dipole that is arbitrarily oriented within a rigid asymmetric rotor, and with a dipole induced in the rotor by the field, was evaluated by perturbation methods. Tables are given for the perturbation of the energy levels so that, for $J \leqslant 2$, the rotational energies of an asymmetric molecule in an electric field may be readily approx. by terms quadratic in the electric field. The effect of accidental degeneracy upon the Stark effect and line intensities was considered. A qualitative discussion of certain features of Stark patterns is given that may be useful in the identification of rotational spectral lines. A.

539.132 : 539.152.2

2639. The interaction of nuclear electric quadrupole moments with molecular rotation in asymmetric top molecules. II. Approximate methods for first-order coupling. BRAGG, J. K. AND GOLDEN, S. *Phys. Rev.*, **75**, 735–7 (*March* 1, 1949).—An expression is developed for the rotational dependence of $\langle \partial^2 V/\partial z^2 \rangle_{Av}$ for asymmetric top molecules. The expression is valid for all rotational energy levels, and requires only a knowledge of the reduced energy spectrum as a function of asymmetry of the rotor. The application of three distinct methods of approximating the energy of the asymmetric rotor to the expression for $\langle \partial^2 V/\partial z^2 \rangle_{Av}$ is described. This permits the calculation of quadrupolar interactions for certain rotational states (in particular, those of high J) for which energies have not yet been tabulated. The expressions which are derived will usually prove to be at least as accurate as the first-order approximation to the quadrupolar interaction, in which $\langle \partial^2 V/\partial z^2 \rangle_{Av}$ is involved. [See Abstr. 1114 (1949)]. A.

539.132 : 541.4

2640. Contributions to the theoretical treatment of ammonium. I. HORVÁTH, J. I. *J. Chem. Phys.*, **16**, 851–7 (*Sept.*, 1948).—Determines the electron distribution, the binding energy and the ionic radius of the positive ammonium molecule ion. A.

539.132 : 541.4

2641. Contributions to the theoretical treatment of ammonium. II. HORVÁTH, J. I. *J. Chem. Phys.*, **16**, 857–64 (*Sept.*, 1948).—Determines the ionization energy of the ammonium molecule and the eigenfrequencies of the positive ammonium molecule ion. A.

539.132 : 541.5

2642. A general solution for the force constants of polyatomic molecules. TORKINGTON, P. Letter in *Nature, Lond.*, **162**, 370 (*Sept.* 4, 1948).—The process of solving the secular equation for the force constants in terms of the fundamental vibration frequencies of polyatomic molecules is, in general, impossible unless some special assumptions are made concerning the force field. A general solution is now presented in matrix form, which gives surprisingly good results with actual examples, and is easy to apply. For molecules in which all the fundamentals fall into the category of "group vibrations," factorization of the secular equation gives a close approximation. The constants obtained are always real, and the normal co-ordinates defined are found to correspond to the vibrations having idealized geometrical forms, e.g. in valence vibrations, the atomic displacement vectors lie directly along the appropriate valence bonds. H. H. HO.

539.132 : 541.57

2643. The molecular diagram method. DAUDEL, P. AND DAUDEL, R. *J. Chem. Phys.*, **16**, 639–43 (*July*, 1948).—The square of the coefficient of the wave function of various valence bond formulae is calculated for a number of resonating organic molecules. Several applications of the derived values are discussed. A.

539.132 : 541.57

Bond orbitals in complexes of transition elements. *See Abstr.* 2788

539.132 : 548.7

2644. Influence of the forces of interaction between the molecules of a molecular lattice on the internal molecular oscillations. DAVIDOV, A. S. Letter in *J. Exp. Theor. Phys., USSR*, **19** (*No.* 2) 181–2 (1949) *In Russian.*—Calculation carried through on a multipole theory, wherein the multipole-moments are expressed by tensors of a corresponding rank, which therefore must characterize the transformation properties of the multipoles concerned. Apart from these tensor forces, the repelling and Van der Waals forces are considered, the energy of which decreases with distance more rapidly than R^{-6}. The given results are obtained on the assumption of rigidly fixed

molecules, which in certain cases does not correspond to facts. However, the results hold approximately in such cases when the excitation is transmitted from molecule to molecule at such speed, that the molecules cannot have reached new equilibrium positions in the meantime. In the opposite case, energy is transferred from the intramolecular oscillations to lattice oscillations, wide absorption bands appear and multiplet and polarization effects are absent. B. F. K.

539.133 : 548.737

2645. Structure of diphenyl. DHAR, J. *Proc. Nat. Inst. Sci. India*, **15** (*No.* 1) 11–14 (1949).—The diphenyl crystal has been further studied with a more efficient X-ray equipment and a Weissenberg goniometer. The planar and linearly extended structure of the diphenyl molecule with the length of the C–C bonds in the two rings 1·42 Å, and that of the link between the rings 1·48 Å, has been examined in the light of the new experimental data. The agreement between the calculated and the observed values of the molecular structure-factors indicates the planar molecular configuration as the most probable. A.

539.133

2646. Study of phase transitions by means of nuclear magnetic resonance phenomena. ALPERT, N. L. *Phys. Rev.*, **75**, 398–410 (*Feb.* 1, 1949).—Although the nuclear magnetic resonance condition generally depends only on the gyromagnetic ratio of the resonating nuclei, the width and amplitude of the resonance depend critically on the substance containing the resonating nuclei. A basic factor affecting the line width is the characteristic flipping time for the substance, i.e. the average time it takes a molecule to change its orientation appreciably. This fact has been applied in a study of a group of molecular solids which exhibit 2 or more phases in order to investigate the mechanisms of these transitions. Of the 2 mechanisms proposed, rotational and order-disorder, the former was eliminated in favour of the latter for HCl, HBr, HI, H_2S and H_2Se, while free molecular rotation is shown to be plausible in CH_4 and CH_3D. A.

539.133 : 541.5 : 535.343–15

Deformation vibrations of H atoms attached to a double bond. *See Abstr.* 2428

539.133 : 541.64

2647. Note on an equation of state for linear macromolecules in monolayers. SINGER, S. J. *J. Chem. Phys.*, **16**, 872–6 (*Sept.*, 1948).—An equation of state for monolayers of large threadlike molecules based on the highly idealized quasi-lattice model is presented, and applied with fair success to the small number of experimental data available. Although protein molecules in monolayers may be highly organized structures, the theory can be applied to them at moderate film pressures without requiring unreasonable values for their molecular parameters. By analogy with the three-dimensional case, the theory requires improvement in order to apply to the low-pressure regions, where experimental differences between protein and polymer films should become more marked. A.

539.133 : 541.67 : 538.22

Diamagnetic susceptibilities of shared electrons. *See Abstr.* 2791

ATOMIC STRUCTURE . ISOTOPES 539.15

539.152

2648. The calculation of atomic structures. HARTREE, D. R. *Rep. Phys. Soc. Progr. Phys.*, **11**, 113–43 (1946–47).—A review of the principles and methods employed in the determination of the self-consistent atomic fields. A complete bibliography is given, and a table of all neutral and ionized atoms for which calculations have been carried out. L. P.

539.152.1

2649. The pair theory of nuclear forces. LOMSADZE, Y. AND MARKOV, M. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 2) 178–80 (1949) *In Russian.*—It is shown that neutretto and anti-neutretto lead to different laws of interaction in the pair theory of nuclear forces (neutretto spin $\frac{1}{2}$). B. F. K.

539.152.1 : 537.531

2650. An investigation of bremsstrahlung by means of the nuclear isomerism of indium. MILLER, W. C. AND WALDMAN, B. *Phys. Rev.*, **75**, 425–32 (*Feb.* 1, 1949).—The metastable state of In^{115} has been used as a detector of a narrow energy band in the continuous X-ray spectrum produced by a monoenergetic electron beam on Au targets. The thin target X-ray isochromat ($h\nu = 1{\cdot}04$ MeV) has been investigated in the neighbourhood of the short wavelength limit. This isochromat is finite at the threshold and constant for at least 400 keV. This agrees with Guth's theory and verifies the assumption that the excitation of In^{115*} is a line absorption. Both the thin target and thick target X-ray excitation curves for In^{115} have been obtained in the region from 1·0 to 2·6 MeV. The thin target curve exhibits a step-like character from 1·0 to 1·9 MeV. The thick-target curve below 2·0 MeV exhibits straight-line segments as expected from the thin target curve, but above 2·0 MeV there are no straight-line segments, in good agreement with the thin-target data and theory. Activation levels have been found at $1{\cdot}04 \pm 0{\cdot}02$ MeV and at $1{\cdot}42 \pm 0{\cdot}02$ MeV. The overall cross-section (per electron incident on a 34 mg/cm² Au target) is 10^{-34} cm² in the region of the threshold. Evidence is presented for the existence of a lower activation level between 0·8 and 0·9 MeV with an overall cross-section (for a similar target) of the order of 10^{-36} cm². A.

539.152.1 : 537.534.74

Scattering of protons in hydrogen. *See Abstr.* 2553

539.152.1 : 539.155

2651. On the stability of the isobaric pair In^{115}–Sn^{115}. GUREVITCH, M. *Phys. Rev.*, **75**, 767–72 (*March* 1, 1949).—A method employing a modified Schuler tube for the excitation of the spectral lines of milligram quantities of material is discussed. The spin of Sn^{115} is found to be $\frac{1}{2}$, and the stability of the pair In^{115}–Sn^{115} to the nuclear transition $In^{115} \rightarrow Sn^{115}$ is highly forbidden on the basis of a spin change of 4. A.

539.152.1 : 539.163.2

2652. Contributions to the study of nuclear isomerism. HOLE, N. *Ark. Mat. Astr. Fys.*, **36 A**, Paper 9, 50 *pp.* (1948) *In English.*—A description of experimental methods used follows a survey of the subject, accompanied by an investigation of the absorption of con-

tinuous β-spectra by various substances. Measurements and results are given on isomeric nuclei of Cd, Hf, Ta, Ir, Pt and Hg. These results are discussed and compared with existing theories. G. J. K.

539.152.1 : 539.185 : 537.133

2653. Non-central interactions between neutron and proton. Hu, T.-M. and Massey, H. S. W. *Proc. Roy. Soc. A*, **196**, 135–59 (*March*, 1949).—Calculations are carried out concerning the magnetic moment of the deuteron, the scattering of neutrons with energies up to 20 MeV by protons and the photodisintegration of deuterons by high energy (17 to 20 MeV) γ-rays assuming various non-central interactions between neutron and proton of the form

$$-\tfrac{1}{3}\tau_1 \cdot \tau_2 - \tfrac{1}{2}(1 + \tau_1 \cdot \tau_2)\left\{-\frac{\hbar^2}{M}\frac{a}{r_0^2}\left[1 + \tfrac{1}{2}g(\sigma_1 \cdot \sigma_2 - 1) + \gamma\left(\frac{3\sigma_1 \cdot \mathbf{r}\sigma_2 \cdot \mathbf{r}}{r^2} - \sigma_1 \cdot \sigma_2\right)\right]\right\} V(r/r_0),$$

where σ_1, σ_2, τ_1, τ_2 are the spin and isotopic spin operators of the particles, r the distance between them. For three "shape" functions V (spherical well, exponential and Yukawa forms) the constants a, g, γ are determined for different values of the range r_0, so as to give correctly the binding energy of the ground state, and the quadrupole moment, of the deuteron and the low velocity neutron-proton cross-section. Calculations are then carried out for chosen values of r_0 and the three forms of the exchange operator for each shape. A comparison is made of the ranges derived from different data for each of the shapes considered. A.

539.152.1 : 539.172.1

Energy level in sulphur nuclei. *See Abstr.* 2716

539.152.2

2654. The magnetic moment of boron^{11}. Zimmerman, J. R. and Williams, D. Letter in *Phys. Rev.*, **74**, 1885 (*Dec.* 15, 1948).—Using a super-regenerative oscillator method, the gyromagnetic ratio of B^{11} was found, by comparison with Na^{23} in an aqueous solution of $Na_2B_2O_4$, to be $1{\cdot}800 \pm 0{\cdot}005$. This would give a magnetic moment of $2{\cdot}700 \pm 0{\cdot}008$ n.m. A. P. F.

539.152.2 : 538.113 : 535.338.32

2655. Erratum: Line shapes in nuclear paramagnetism. Pake, G. E. and Purcell, E. M. *Phys. Rev.*, **75**, 534 (*Feb.* 1, 1949).—See Abstr. 663 (1949).

539.152.2 : 539.132

The interaction of nuclear electric quadrupole moments with molecular rotation in asymmetric top molecules. *See Abstr.* 2639

539.153

2656. Nuclear shell structure and isomerism. Feenberg, E. Letter in *Phys. Rev.*, **75**, 320–2 (*Jan.* 15, 1949).—In the nuclear shell model a closed 40-particle shell $(1s)^2\ (2p)^6\ (3d)^{10}\ (4f)^{14}\ (3p)^6\ (2s)^2$ is suggested by the properties of odd nuclei with Z or $N = 37$, 39 or 41, and $3p$ and $2s$ should rise above $5g$ shortly after the closing of the shell. Properties of nuclei in this region are tabulated. The occurrence of many cases of isomerism with predicted spin values (based on the assumption that all angular momentum is contributed by the odd particle or hole) $\frac{1}{2}$ or $\frac{7}{2}$, $\frac{9}{2}$, and of few cases for $\frac{3}{2}$ or $\frac{5}{2}$, supports the proposed shell structure. T. G.

539.153 : 537.

Lifetime of slow positrons. *See Abstr.* 2488

539.153 : 538.222 : 538.569

Paramagnetic resonance absorption in chrome alum. *See Abstr.* 2608

539.15

2657. On the magnetic moments of C^{13}, F^{19}, Tl^{20} and Tl^{205}. Poss, H. L. *Phys. Rev.*, **75**, 600–6 (*Feb.* 1, 1949).—The resonance absorption method has been applied to the measurement of the moments of C^{13}, F^{19}, Tl^{203} and Tl^{205} in terms of the proton moment. The observed ratios of g-factor to that of the proton are as follows. C^{13}: $0{\cdot}25143 \pm 0{\cdot}00005$; F^{19}: $0{\cdot}94077 \pm 0{\cdot}0001$; Tl^{203}: $0{\cdot}571499 \pm 0{\cdot}0000$; Tl^{205}: $0{\cdot}577135 \pm 0{\cdot}00005$. By taking $5{\cdot}5791 \pm 0{\cdot}0016$ for the proton gyromagnetic ratio, the values of the moments in nuclear magnetons are: $\mu(C^{13}) = 0{\cdot}7016 \pm 0{\cdot}0004$; $\mu(F^{19}) = 2{\cdot}626 \pm 0{\cdot}001$; $\mu(Tl^{203}) = 1{\cdot}612$; $\mu(Tl^{205}) = 1{\cdot}628$. For the Tl isotopes $\mu_{205}/\mu_{203} = 1{\cdot}00986 \pm 0{\cdot}00005$. The results for C^{13} and F^{19} are in close agreement with the molecular beam values.

539.155.

2658. Concentration of isotopes of mercury in countercurrent molecular stills. Madorsky, S. L., Bradt, P. and Straus, S. *J. Res. Nat. Bur. Stand. Wash.*, **41**, 205–21 (*Sept.*, 1948).—Hg was refluxed in countercurrent molecular stills in order to concentrate Hg^{204}. Two glass stills, with heater and cooler placed outside the distillation columns, and one still, consisting of a glass column heated externally and a stainless-steel cooler placed concentrically inside the column, were used. As compared with a 10-cell steel column described previously, these columns showed poor performance, mainly because the hold-up was too small. There are definite indications, however, that with liquids having a lower surface tension than Hg, these columns will perform as well as the 10-cell steel column.

539.155.

2659. The occurrence of He^3 in natural sources of helium. Aldrich, L. T. and Nier, A. O. *Phys. Rev.*, **74**, 1590–3 (*Dec.* 1, 1948).—An investigation of the He^3/He^4 abundance ratio in He extracted from the atmosphere, gas wells and a number of minerals has been made. Wide variations in this ratio are observed. He^3 is observed in all sources of helium except radioactive minerals. This suggests the possibility of a primordial source as well as more recent sources for this isotope.

539.155.

2660. A new naturally occurring isotope of dysprosium. Hess, D. C., Jr. and Inghram, M. G. Letter in *Phys. Rev.*, **74**, 1724–5 (*Dec.* 1, 1948).—Dy^{156}, a new isotope, was observed in a mass spectrometer with a surface ionization source, with abundance $\sim 0{\cdot}05\%$. Checks were made with 3 oxide samples, to investigate the effects of impurities. T. G. P.

539.155.2

2661. Isotopic constitution of ytterbium. Hayden, R. J., Hess, D. C., Jr. and Inghram, M. G. Letter

Phys. Rev., **75**, 322–3 (*Jan.* 15, 1949).—New values of the relative abundances of the 7 known Yb isotopes were determined in a mass spectrometer, with ~1% accuracy. Upper limits for other possible isotopes were determined. T. G. P.

539.155.2 : 533.15

2662. Countercurrent gaseous exchange method for the separation of isotopes. BERNSTEIN, R. B. AND TAYLOR, T. I. *J. Chem. Phys.*, **16**, 903–16 (*Sept.*, 1948).—A method is described for isotope enrichment by countercurrent gaseous exchange in a thermal diffusion column. The theory is derived for two cases of interest: diffusion limited and reaction-rate limited. Solutions of the equations are presented for the over-all separation S at the steady state as a function of the following: single stage enrichment factor α; diffusion constant D or exchange rate constant k; length of column Z; and the convective flow L, which in turn depends on pressure, temperature, column dimensions, etc. The results may be expressed in the usual form $S = \alpha^N$. For the diffusion-limited case $N = 4\pi D\bar{c}Z/L$, where $\bar{c}$ = moles of gas per cc. For the reaction-rate limited case the number of theoretical plates per unit length is given by the expression $N/Z = k/v$, where v is the convective velocity. Experiments are described in which C^{13} was concentrated by the exchange reaction $C^{12}O_2 + C^{13}O \rightleftharpoons C^{13}O_2 + C^{12}O$. The observed dependence of the over-all separation upon the operational variables is consistent with the theory. A.

537.155.2 : 535.375.5

Fine structure of Raman lines due to chlorine isotopes. *See Abstr.* 2448

RADIOACTIVITY . α-, β- AND γ-RAYS 539.16

539.16

2663. Radiations of uranium Y. KNIGHT, G. B. AND MACKLIN, R. L. *Phys. Rev.*, **75**, 34–8 (*Jan.* 1, 1949).—The radioactivity of UY (Th^{231}) has been re-investigated. Samples were prepared by growth from U^{235} largely freed of U^{238}, and absorption, decay and coincidence experiments were run. The presence of the 210 keV β-ray was re-confirmed, and a 35 keV γ-ray 82% converted in the L shell was discovered. The ½-life of UY was determined as 25·5 hours. A.

539.16

2664. Experiments on the effect of atomic electrons on the decay constant of Be^7. SEGRÈ, E. AND WIEGAND, C. E. *Phys. Rev.*, **75**, 39–43 (*Jan.* 1, 1949).—In an attempt to detect a possible influence of the atomic electrons on the radioactive decay constant λ of Be^7 $\lambda_{BeO}-\lambda_{Be}$ was measured and found $(-3{\cdot}0 \pm 1{\cdot}8)10^{-4}\lambda_{Be}$. A method of measuring mean lives of radioactive substances in a time short compared with the mean life is described. A.

539.16 : 539.165 : 539.166

2665. On simultaneous beta-gamma emission from nuclei. LONGMIRE, C. L. *Phys. Rev.*, **75**, 15–17 (*Jan.* 1, 1949).—The possibility of simultaneous β-γ-emission as an alternative process for strongly forbidden β-decay is investigated. The lifetime of the compound transition is estimated, and the β- and γ-spectra are given. Combinations of spin and parity for which the compound transition would not be obscured by the ordinary β transition are listed. A.

539.16.08

2666. Measurement of the radioactive decay constant of ThC′ using a coincidence method. VAN NAME, F. W., JR. *Phys. Rev.*, **75**, 100–3 (*Jan.* 1, 1949).—The radioactive ½-life of ThC′ has been measured using a delayed coincidence circuit of high resolution. A theory of the effect on the coincidence rate of variations in pulse formation in counters has been developed and compared with experiment. The radioactive decay constants are: $T = (2{\cdot}2 \pm 0{\cdot}1)\times10^{-7}$ sec, $\lambda = (3{\cdot}15 \pm 0{\cdot}14)\times10^6$/sec. A.

539.16.08 : 537.542 : 531.791

A Geiger–Mueller counting unit. *See Abstr.* 2564

539.162

2667. Radioactive branching. FEATHER, N. *Rep. Phys. Soc. Progr. Phys.*, **11**, 19–31 (1946–47).—An introduction to the subject and an attempt at exact definition is followed by a survey of the results of recent discoveries of cases of radioactive branching. These are classified as α/β, α/capture, β/β, β/γ, β^+/capture, β/capture and β/β^+ branchings. The whole phenomenon is discussed in general terms and the emphasis throughout is on the need for further careful investigations. R. W. P.

539.162

2668. The electrostatic interaction and low energy particles in alpha-radioactivity. PRESTON, M. A. *Phys. Rev.*, **75**, 90–9 (*Jan.* 1, 1949).—In α-decay, after the particle has been emitted, the asymmetrical electric field of the residual nucleus can cause the α-particle to alter its total energy in conjunction with a change in the state of the nucleus. Since the ability of a particle to penetrate the potential barrier increases rapidly with its energy, the number of particles of each possible energy finally escaping will not be in accord with the decay constants predicted by the Geiger–Nuttall law. It is found that the effect is not important (a quantitative estimate is given), except in the case where the difference between the energies of the two states is < about 500 keV. The investigation allows a theoretical study of the experiments in which Chang found anomalous fine structure in the α-spectra of Po and Ra [Abstr. 1682 (1946), 964 (1947)]. It is found that very improbable assumptions are required to reconcile these experimental results with the theory presented here. No additional effects connected with the nucleus which could alter this conclusion have been found. A.

539.162

2669. Bound electron creation in the decay of tritium. SHERK, P. M. *Phys. Rev.*, **75**, 789–91 (*March* 1, 1949).—The relative probabilities of K creation and β-emission are calculated for both molecular and atomic tritium. This ratio is shown to be 0·0035 for the molecule and 0·0065 for the atom, assuming the maximum kinetic energy of the β-rays to be 16·9 keV. A.

539.162 : 539.163.2 : 539.18

2670. Theory of beta-decay in the case of a low upper limit of the beta-spectrum and a finite neutrino mass. MARKOV, M. A. *J. Exp. Theor. Phys., USSR*, **18**, 903–6 (*Oct.*, 1948) *In Russian.*—The calculation is based on the assumption of non-zero mass of the neutrino. It is shown that for a low upper limit of the β-spectrum the neutrino mass plays a very different part in different variants of the theory of the β-disintegration. The results are exemplified on the case of H^3. A.

539.163.1

2671. Measurement of the half-period of polonium 213. JELLEY, J. V. *Canad. J. Res. A*, **26**, 255–67 (*July*, 1948).—The ½-value period of the shortest-lived member of the $(4n + 1)$ radioactive series, Po^{213}, has been determined as $4{\cdot}2 \pm 0{\cdot}8$ μsec by a coincidence method using a variable coincidence resolving time. The ½-value period of ThC′ was also measured as $0{\cdot}34 \pm 0{\cdot}06$ μsec. A. O. S.

539.163.1

2672. Measurement of the half-life of double beta-decay from $_{50}Sn^{124}$. FIREMAN, E. L. Letter in *Phys. Rev.*, **75**, 323–4 (*Jan.* 15, 1949).—2 samples of Sn, one with 54% of Sn^{124}, the other with 0·4%, were mounted so that β–β coincidences could be observed on both samples simultaneously, using thin-window counters. The samples were alternated between the pairs of counters. A real difference between the specimens of 2 coincidence counts per hr was found. If ascribed to double β-decay, this means that no neutrinos are emitted in the process, as otherwise the observed lifetime $(0{\cdot}4\text{–}0{\cdot}9 \times 10^{16}$yr) would be $\sim 10^{10}$ times too short. A. P. F.

539.163.1

2673. Mass spectrometer determination of the half-life of Xe^{133}. MACNAMARA, J., COLLINS, C. B. AND THODE, H. G. Letter in *Phys. Rev.*, **75**, 532–3 (*Feb.* 1, 1949).—The ½-life was found to be $5{\cdot}271 \pm 0{\cdot}002$ days, by determination of the ratios of the concentration of the mass 133 isotope and the stable ones at ~ two-day intervals [Abstr. 1931 (1947)]. B. R.

539.163.1 : 539.165

2674. On the half-life of Rb^{87}. HAXEL, O., HOUTERMANS, F. G. AND KEMMERICH, M. Letter in *Phys. Rev.*, **74**, 1886–7 (*Dec.* 15, 1948).—Counting and coincidence measurements on β-particles emitted from the two sides of thin layers of RbCl evaporated on a silver-coated Zapon foil ($\sim 0{\cdot}1$ mg/cm²) indicated that two particles ($\sim$10 keV, $\sim$135 keV) are emitted per disintegration, the decay electrons probably having the lower energy. Check counts were made with RbCl sources on Al foils. The mean ½-life of Rb^{87} was $(6{\cdot}0 \pm 0{\cdot}6) \times 10^{10}$ yr, in agreement with the geological value. A. O. S.

539.163.2

2675. Beta-decay of Be^{10} and theory of beta-decay. MARSHAK, R. E. *Phys. Rev.*, **75**, 513–18 (*Feb.* 1, 1949).—If a spin change of 3 units is involved in the $Be^{10} \rightarrow B^{10}$ transition—as seems to be indicated at present—theoretical predictions of the minimum ½-life lead to an essentially unique β-ray spectrum very different from the allowed shape. Measurement of this spectrum will provide a crucial test of existing theories of β-decay. A.

539.163.2

2676. Some characteristics of antimony (125). MANDEVILLE, C. E. AND SHAPIRO, E. Letter in *Phys. Rev.*, **75**, 897–8 (*March* 1, 1949).—The β-end point was found by absorption in Al to be $0{\cdot}704$ MeV, and the β–γ-coincidence rate found independent of β-energy to the above endpoint, suggesting a simple β-spectrum followed by $0{\cdot}31$ MeV of "immediate" γ-energy per β-particle. The conversion electron endpoint of Te^{125*} was found by absorption methods to be 120 or 93 keV depending on the choice of end-point. B. R.

539.163.2

2677. The gamma-rays following Au^{198} β-decay. SAXON, D. AND HELLER, R. Letter in *Phys. Rev.*, **75**, 909–10 (*March* 1, 1949).—A search was made without success for internal conversion lines from 157 and 208 keV γ-rays previously reported [Abstr. 1632 (1948)]. The conversion coefficients for the 411 keV line were measured. The ½-life previously reported [Abstr. 2181 (1948)] has been reassessed to $2{\cdot}69 \pm 0{\cdot}02$ days. B. R.

539.163.2 : 539.165

2678. On the β-radiation of mesothorium 1 and mesothorium 2. LECOIN, M., PEREY, M. AND TEILLAC, J. *J. Phys. Radium*, **10**, 33–41 (*Feb.*, 1949) *In French.*—The β-ray spectra of $MsTh_1$ and $MsTh_2$ were obtained with a Wilson chamber operated at different pressures: $MsTh_2$ emits (not simultaneously) ~2 β-particles per disintegration, in 2 groups intersecting at ~60 keV; $MsTh_1$ emits $\sim 0{\cdot}15$ electrons per disintegration with energies between 1·5 and 18 keV. Details of the chemical separation and purification of $MsTh_1$ and $MsTh_2$ sources are given. A. O. S.

539.163.2 : 539.165.1 : 537.12/.13

2679. Maximum positron to negatron ratio in the decay of Cl^{36}. JOHNSTON, F. AND WILLARD, J. E. Letter in *Phys. Rev.*, **75**, 528–9 (*Feb.* 1, 1949).—Pb absorption curves revealed two γ-rays of energy $0{\cdot}10$ and $0{\cdot}57$ MeV. If the latter is assumed to be annihilation radiation, the positron emission rate is found to be $3 \times 10^{-4} \times$ negatron rate. B. R.

539.163.2 : 539.166

2680. γ-radiation from Au^{198}. SIEGBAHN, K. AND HEDGRAN, A. Letter in *Phys. Rev.*, **75**, 523–4 (*Feb.* 1, 1949).—A search was made without success for conversion lines in Pb from 157 and 208 keV γ-rays previously reported [Abstr. 1632 (1948)]. If present, these lines must have intensity <2% of that of the 411 keV line. γ–γ-coincidences were found to be comparable with those from the uncorrelated γ-rays from Fe^{59}. Internal conversion coefficients were measured for the 411 keV line. The main γ-ray energy was found to be $411{\cdot}0 \pm 1$ keV. B. R.

539.163.2 : 539.167

The radiations from 2·7-day Au^{198}. *See Abstr.* 2697

539.164 : 535.376

Emission of u.v. radiation in gases traversed by alpha-particles. *See Abstr.* 2449

539.164 : 537.531 : 541.14

2681. Oxidising and reducing actions of α- and X-radiations. HAISSINSKY, M. AND LEFORT, M.

C.R. Acad. Sci., Paris, **228**, 314–16 (*Jan.* 24, 1949) *In French.*—Irradiation of neutral aqueous solutions of KI releases I_2. With α-particles, the oxidation proceeds linearly with radiation dose; but with X-rays, an equilibrium is reached. The same equilibrium is also reached when a solution of I_2 is irradiated with X-rays. No reduction of I_2 occurs with α-particles. The initial ionic yield in the oxidations is 3 times as great with X-rays as with α-particles, and it increases rapidly with acidity. KIO_3 is reduced equally by α- and X-radiation. Both radiations oxidize KNO_2 and reduce KNO_3. C. B. A.

539.164 : 539.172.1

Particles from deuteron bombardment of aluminium. *See Abstr.* 2717

539.164 : 539.172.1 : 771.531

Stars produced by alpha-particles. *See Abstr.* 2721

539.164 : 539.172.11

Fission of uranium by alpha-particles. *See Abstr.* 2722

539.164 : 541.14

Decomposition of N_2O by α-rays. *See Abstr.* 2783

539.164 : 541.14 : 537.531

Formation of hydrogen peroxide in water by alpha-rays. *See Abstr.* 2780

539.165 : 539.18

2682. Electron-neutrino angular correlation in the beta-decay of He^6. Allen, J. S., Paneth, H. R. and Morrish, A. H. *Phys. Rev.*, **75**, 570–7 (*Feb.* 15, 1949).—The recoil nuclei emitted during the β-decay of He^6 have been detected by means of an electron multiplier tube, and the β-rays counted by means of an end window Geiger counter. The energy spectrum of the recoils has been studied by recording coincidences between the 2 detectors as a function of the retarding potential between a set of grids in the path of the recoils. β-recoil ion coincidences have been observed when the angle between the directions of emission of the β-particle and of the recoil ion was 180 degrees and also 162 degrees. In both cases the best agreement was obtained when the recoil spectra were compared with the curves predicted by the $1 - (v/3c)\cos\theta$ electron-neutrino angular correlation. A.

539.165.08

2683. The relation of backscattering to self-absorption in routine beta-ray measurements. Yankwich, P. E. and Weigl, J. W. *Science*, **107**, 651–3 (*June* 18, 1948).—Using a sample of C^{14}-active $BaCO_3$ mounted on an extremely thin plastic film, measurements were made of the enhancement of counting rate due to various scattering materials beneath the film. Heavy metals give an increase up to 40%; light materials, e.g. wax, give only 4%. The results for two different counter geometries are tabulated. F. T. F.

539.165.08 : 614.8

2684. Radiation from a flask containing various amounts of radioactive phosphorus. Cowing, R. F. and DeAmicis, E. *Science*, **107**, 684 (*June* 25, 1948). —Measurements of β-ray intensity at various distances from a flask containing P^{32} in solution are given, and indicate the length of time for which such a flask may safely be handled in practical manipulation. F. T. F.

539.165.8

2685. The neutrino and the recoil of nuclei in beta disintegrations. Pontecorvo, B. *Rep. Phys. Soc. Progr. Phys.*, **11**, 32–42 (1946–47).—This report contains a survey of experimental work on the recoil of nuclei in β-disintegrations and its bearing on the neutrino hypothesis. The author deals in particular with the work of Leipunski, Crane and Halpern, Allen, and Jacobsen and Kofoed-Hansen. R. W. P.

539.166

2686. Angular correlation of scattered annihilation radiation. Bleuler, E. and ter Haar, D. *Science*, **108**, 10–11 (*July* 2, 1948).—The cross-sections are calculated for coincidence measurements of the scattering of the two photons produced by pair annihilation. Previously published results [Abstr. 1907 (1948), 3640 (1947)] are obtained by splitting the wave-function of the two photons into 4 parts, each corresponding to plane polarizations of the pair. The total section is the sum of those for each part. G. J. K.

539.166

2687. Gamma-rays from deuteron reactions. Alburger, D. E. *Phys. Rev.*, **75**, 51–6 (*Jan.* 1, 1949). —γ-rays from Na, Mg, Al, Si, P, S and PbO_2 targets under cyclotron bombardment by 3·7 MeV deuterons have been measured by coincidence absorption of Compton electrons. With PbO_2, Al and Mg, Compton distributions were also obtained by means of a thin lens magnetic spectrometer. Correlation of several of the measured values can be made with excited states of N^{14}, O^{17} and Si^{28} as obtained from other information. The predominant γ-rays have moderately large energy, being 8·8 MeV in one case, indicating a preference for direct transitions from states of high excitation to the ground state of the product nucleus. A.

539.166

2688. The magnetic internal conversion coefficient. Drell, S. D. *Phys. Rev.*, **75**, 132–6 (*Jan.* 1, 1949).— The magnetic internal conversion coefficient for *K*-electrons is rederived with the Dirac current for the electron introduced into the electron-nucleus interaction matrix. Beyond resolving a discrepancy found in the literature, the formula obtained indicates magnetic conversion to be an effect of importance comparable with electric conversion. Its influence on the total conversion coefficient, on the *K*- to *L*-shell conversion ratio, and on the lifetimes of isomeric levels is discussed. A.

539.166

2689. The conversion of gamma-rays in In^{111}. Boehm, F., Huber, O., Marmier, P., Preiswerk, P. and Steffen, R. *Helv. Phys. Acta*, **22** (*No.* 1) 70–7 (1949) *In German.*—The coefficients of *K*- and *L*- internal conversion of In^{111} γ-rays are investigated by means of coincidence measurements. The following results have been obtained:

$$E_\gamma = 173 \text{ keV}: (N_e/N_\gamma)_K = (8{\cdot}1 \pm 0{\cdot}8)10^{-2};$$
$$(N_e/N_\gamma)_L = (0{\cdot}9 \pm 0{\cdot}1)10^{-2}; \quad E_\gamma = 247 \text{ keV}:$$
$$(N_e/N_\gamma)_K = (3{\cdot}6 \pm 0{\cdot}5)10^{-2};$$
$$(N_e/N_\gamma)_L = (0{\cdot}6 \pm 0{\cdot}1)10^{-2}.$$

From comparison with the theories of internal conversion the multipole orders of these γ-rays are

determined. Electric quadrupole and magnetic dipole radiations are found to occur in the 173 keV transition while electric quadrupole radiation is present in the 247 keV γ-ray. Both transitions are not accompanied by parity changes. A.

539.166 : 537.54

2690. The detection of gamma-rays with thallium-activated sodium iodide crystals. HOFSTADTER, R. *Phys. Rev.*, **75**, 796–809 (*March* 1, 1949).—Thallium-activated NaI crystals may be used as efficient detectors of γ-rays and other ionizing radiations. The crystals are used in combination with a photo-multiplier after the manner of Kallmann. Curves are given which show the duration of the light emission process, the distribution of light pulse sizes, the energy discrimination possibilities, and the dependence of number of counting events on photo-multiplier voltage and amplifier gain. Comparison curves are shown for NaI(Tl) and anthracene. A description is given of the method of preparation of polycrystalline samples and single crystal specimens of the NaI(Tl) phosphor. A few remarks are made concerning the combination of alkali halide phosphor crystals with photographic plates. A.

539.166 : 539.167.3

2691. Converted gamma-radiation from silver, cadmium, indium, praseodynium, and rhenium. CORK, J. M., SHREFFLER, R. G. AND FOWLER, C. M. *Phys. Rev.*, **74**, 1657–9 (*Dec.* 1, 1948).—By use of β-spectrometers and absorption methods the $\frac{1}{2}$-lives and energy characteristics of radioactive isotopes of Ag, Cd, In, Pr and Rh have been determined. The activities studied were induced by neutron capture in a pile. Ag of $\frac{1}{2}$-life 282 d had γ-rays of energy 114·2, 655, 880 keV and 1·38 MeV. Cd appears to yield several radioactivities, one of which is a positron emitter and converted γ-rays of 86·3 and 336·9 keV are observed. The well-known 48 d activity in In has a converted γ-ray whose energy is more closely determined as 190·9 keV. Pr also displays a complex decay curve, but associated with a short $\frac{1}{2}$-life previously reported as 19·2 hr are γ-rays of 133·7, 328·9, 489·6 and 624 keV, and by absorption a high energy γ-ray of 2·1 MeV. Rh is strongly activated in the pile, yielding two radioactivities, of $\frac{1}{2}$-lives 16 hr and 91 hr. A converted γ-ray of 153·6 keV is found for the short-lived activities, and γ-energies of 122·7, 135·8, 127·5 and 640 keV exist for the longer-lived activity. A.

539.166 : 539.172.3

88-Mev gamma-ray cross-sections. *See Abstr.* 2726

539.166.1

2692. The application of a magnetic lens spectrometer to the measurement of gamma-radiation from Zn^{65} and Co^{60}. JENSEN, E. N., LASLETT, L. J. AND PRATT, W. W. *Phys. Rev.*, **75**, 458–65 (*Feb.* 1, 1949).—A thin magnetic lens spectrometer for the investigation of γ-ray spectra is described. The effect of the thickness of the radiator used for the production of photoelectrons and the influence of the earth's magnetic field are reported. Based on a calibration of the instrument by means of annihilation radiation and the F line of ThB, energy values of $1{\cdot}10_6$ MeV for the γ-ray of Zn^{65}, and $1{\cdot}15_5$ and $1{\cdot}31_7$ MeV for the 2 lines of Co^{60} are obtained. The probable error is estimated as 0·5%. A.

539.166.74

2693. Multiple Compton scattering. FAUST, W. R. AND JOHNSON, M. H. *Phys. Rev.*, **75**, 467–72 (*Feb.* 1, 1949).—An experimental and theoretical investigation has been made of the γ-radiation in water produced by a uniform distribution of radioactive Co. The intensity and spectral distribution of the radiations are determined essentially by the multiple Compton scattering that takes place in the liquid. An approximate quantitative treatment is presented in which the multiple scattering is considered as a succession of steps which are the same for every emitted γ-ray. Although the method is crude, the numerical results both for the absolute counting rate of a submerged counter and for the effect of shielding around the counter are in close agreement with experiment. A.

539.166.84 : 537.534.8 : 537.13

2694. Angular distribution of γ-quanta formed in the annihilation of positrons. VLASOV, N. A. AND TSIRELSON, E. A. *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 5) 879–82 (1948) *In Russian.*—A check on the divergences between experimental (Alikhanov, Alikhanian and Artsimovich [Abstr. 3338 (1936)]), and theoretical (Beringer and Montgomery [Abstr. 1869 (1942)]) results. By using groups instead of single counters the experimental set-up of the authors could be made $\sim 200\times$ as efficacious as Beringer and Montgomery's. Two test series prove that $\geqslant 95\%$ of the annihilation γ-quanta pairs fly off at angles of $180° \pm 1°$. By the conservation of energy and momentum a corresponding part of the positrons annihilates with an energy <80 eV and also the annihilation γ-radiation is absolutely monochromatic. Further improvements of the apparatus and method are reported to be under way. B. F. K.

539.167

2695. The radioactivities of some high mass isotopes of cobalt. PARMLEY, T. J., MOYER, B. J. AND LILLY, R. C. *Phys. Rev.*, **75**, 619–23 (*Feb.* 15, 1949).—By n bombardment of samples of Ni enriched in isotopes 61, 62 and 64, respectively, the following radioactivities have been identified: Co^{61}, β^- 1·3 MeV, no γ, $\frac{1}{2}$-life 1·75 hr.; Co^{62}, β^- 2·3 MeV, γ 1·3 MeV, $\frac{1}{2}$-life 13·9 min. Evidence is also presented for a 1·6-min β- and γ-activity associated with Co^{62}, and for a 4- to 5-min activity possibly of Co^{64}. A.

539.167 : 537.133

2696. Use of enriched molybdenum in cross-section measurements of the $(p, n) : (p, \gamma)$ and $(d, n) : (d, 2n)$ reactions. KUNDU, D. N. AND POOL, M. L. *Phys. Rev.*, **74**, 1574–6 (*Dec.* 1, 1948).—Mo natural isotopic composition and Mo enriched in isotope 94 were subjected to bombardments with protons and deuterons. After monitoring, and from the saturation intensities and the nature of the decay of the radioactive substances produced, simultaneous equations were set up which yielded the relative values for the reaction cross-sections. For 5 MeV protons, $Mo^{94}(p, \gamma) : Mo^{95}(p, n) : Mo^{95}(p, \gamma) : Mo^{96}(p, n) = 1 : 260 : 40 : 400$. For 10 MeV deuterons, $Mo^{94}(d, n) : Mo^{95}(d, 2n) : Mo^{95}(d, n) : Mo^{96}(d, 2n) = 1 : 13 : 17 : 2{\cdot}5$. The method is applicable to a wide range of elements. A.

539.167 : 539.163.2

2697. The radiations from 2·7-day Au^{198}. Levy, P. W. and Greuling, E. *Phys. Rev.*, **75**, 819–26 (*March* 1, 1949).—The radiations from the 2·7 day Au^{198} activity were investigated with a counter and photographically recording β-ray spectrometer. The shape of the continuous β-ray spectrum is essentially that of an allowed spectrum with some additional intensity in the region below 0·6 MeV. The maximum energy of the spectrum is $0{\cdot}966 \pm 0{\cdot}010$ MeV. Very strong conversion lines are observed from a γ-ray of $0{\cdot}408 \pm 0{\cdot}004$ MeV, and weak conversion lines attributed to γ-rays of $0{\cdot}157 \pm 0{\cdot}002$ and $0{\cdot}208 \pm 0{\cdot}002$ MeV were detected. These weak lines and the deviation of the spectrum from the theoretically permissible spectra suggest that the β-ray spectrum may be complex with a component of $0{\cdot}601 \pm 0{\cdot}016$ MeV maximum energy occurring in 15%, or less, of the disintegrations. This suggested mode of decay is consistent with the theoretical analysis of the spectrum and ½-life. In terms of this theory the 0·966 MeV transition is described by the polar-vector or pseudo-scalar interaction corresponding to a nuclear spin change of ± 1, with no parity change. A.

539.167 : 541.14

2698. Chemical effects in nuclear electron emission. Davies, T. H. *J. Phys. Coll. Chem.*, **52**, 595–603 (*March*, 1948).—An attempt was made to separate the nuclear effects and the purely chemical consequences of β-decay. The method depended on studying radicals for which the transition $Z \rightarrow Z + 1$ in one of the atoms did not of itself produce instability, e.g. $SeO_3^{--} \rightarrow BrO_3^-$. Disruption of the structure could then be ascribed to nuclear recoil during β-emission. The daughter nucleus had to be radioactive also in order to be observable; suitable parent substances were extracted from fission products. No conclusive evidence was obtained. A. P. F.

539.167 : 771.531 : 537.534

2699. Grain density in photographic tracks of heavy particles. Blau, M. *Phys. Rev.*, **75**, 279–82 (*Jan.* 15, 1949).—The relation between grain density in photographic tracks and particle energy has been derived theoretically assuming that the probability that a grain be developed is given by $P = c(1 - \exp[-b(dE/dR)^{\frac{1}{2}}])$. Using a single pair of parameters b and c all experimental curves so far published for alpha-particles, tritons, protons, π- and μ-mesons can be well represented. A.

539.167.3

2700. The disintegration scheme of I^{131}. Metzger, F. and Deutsch, M. *Phys. Rev.*, **74**, 1640–4 (*Dec.* 1, 1948).—The radiations of I^{131} have been studied with a magnetic lens spectrometer and coincidence techniques using "Kallmann" counters. 4 γ-rays of 80, 283, 363 and 638 keV were detected both by their internal conversion electrons and by photoelectrons emitted from different convertors. A β-ray spectrum of 600 keV maximum energy constitutes about 85% of the disintegrations and leads to a state of Xe^{131} with 363 keV excitation. In about 6% of the disintegrations, the transitions from this level to the ground state take place by the successive emission of an 80 keV and a 283 keV γ-ray. 15% of the disintegrations proceed by the emission of a 315 keV β-spectrum followed by a 638 keV γ-ray. A.

NUCLEAR REACTIONS 539.17

539.17

2701. The Szilard–Chalmers reaction in the chain-reacting pile. Williams, R. R. *J. Phys. Coll. Chem.*, **52**, 603–11 (*March*, 1948).—Separation of an active isotope by this method is limited in efficiency if normal atoms of the element are ejected from chemical combination by the ambient γ- and neutron-radiation, and if the active isotope itself is subject to decomposition under radiation. The effects are evaluated, and it is shown that enrichment by Szilard–Chalmers effect decreases as the radiation flux and the time of irradiation are increased. Experiments in support of these conclusions are described. A. P. F.

539.17

2702. Cyclotron targets: preparation and radiochemical separation. III. Na^{22}. Irvine, J. W., Jr. and Clarke, E. T. *J. Chem. Phys.*, **16**, 686–90 (*July*, 1948).—Two methods for separating Na^{22} from magnesium cyclotron targets are described. Deuteron excitation functions for $Mg^{26}(d,\alpha)Na^{24}$ and $Mg^{24}(d,\alpha)Na^{22}$ and thick target yields for the two Na isotopes are given. The maximum values of the cross-sections are $\sigma_{Na^{24}} = 0{\cdot}095 \times 10^{-24}$ cm² at 8·5 MeV and $\sigma_{Na^{22}} = 0{\cdot}16 \times 10^{-24}$ at 9·5 MeV. With 14 MeV deuterons the thick target yields are $Na^{24} = 8{\cdot}7rd/\mu Ah$ and $Na^{22} = 65mrd/\mu Ah$. A.

539.17

2703. Design, auxiliary equipment and services for a radiochemical laboratory. Guest, G. H. and Cook, L. G. *Nat. Res. Coun. Can., Publ. CRHR* 368 (*No.* 1714) (1948).—A brief account, with photos, of the precautions to be taken when working with radio-isotopes and the monitoring and safety equipment required.

539.17

2704. Threshold and resonances in $C^{14}(p,n)N^{14}$ reaction and energy levels of N^{15}. Shoupp, W. E., Jennings, B. and Sun, K. H. *Phys. Rev.*, **75**, 1–14 (*Jan.* 1, 1949).—The threshold energy required to induce the (p, n) reaction in C^{14} has been measured to be $E_t = 0{\cdot}664 \pm 0{\cdot}009$ MeV or a reaction energy of $-0{\cdot}620 \pm 0{\cdot}009$ MeV. This reaction is the inverse of the $N^{14}(n,p)C^{14}$ process studied by Hughes and Eggler [Abstr. 2554 (1948)] and their observed reaction energy $Q_{n,p} = 0{\cdot}597 \pm 0{\cdot}009$ MeV can be compared with the negative of the reaction energy observed here. 6 resonances have been observed in the process at 1·14, 1·30, 1·47, 2·05, 2·21 and 2·65 MeV, 3 of which can be correlated with those previously observed in the $N^{14}(n,p)$ reaction. The cross-section at the first resonance at 1·14 MeV has been measured to be approximately 0·7 barn. A.

539.17 : 521 : 629.19

2705. The atomic rocket. I. Shepherd, L. R. and Cleaver, A. V. *J. Brit. Interplan. Soc.*, **7**, 185–94 (*Sept.*, 1948).—The fundamental problems of rocket propulsion are discussed. The limitations of chemical

fuels for interplanetary journeys lead to the consideration of nuclear energy; this may be used to supply heat to a working fluid which is then ejected at high velocity. Some of the many difficulties, including radiation hazards, are discussed quantitatively.

T. G. P.

539.17 : 521 : 629.19

2706. The atomic rocket. II. SHEPHERD, L. R. AND CLEAVER, A. V. *J. Brit. Interplan. Soc.*, **7**, 234–41 (*Nov.*, 1948).—The choice of a suitable propellant fluid is considered on the basis of the well-known results for the expansion of an ideal gas through a rocket nozzle. Performance is largely controlled by the max. temp. θ to which the propellant can be heated. For a given θ, the highest exhaust velocity would be obtained with the propellant having the lowest molecular weight M at this temp. Dissociation is shown to be beneficial both in lowering M and in increasing the heat capacity of the propellant. H would give an exhaust velocity > any other possible propellant but possesses poor storage properties in the liquid state. NH_3, which dissociates at temps. as low as 1 000°K, is considered as an example of an alternative propellant. Mean molecular weights and heat capacities are quoted for H and NH_3 at 50 atmos. pressure, in the range 3 000°K–5 000°K. Exhaust velocities of 5–15 km/sec are considered possible.

L. R. S.

539.17 : 521 : 629.19

2707. The atomic rocket. III. SHEPHERD, L. R. AND CLEAVER, A. V. *J. Brit. Interplan. Soc.*, **8**, 23–37 (*Jan.*, 1949).—Problems involved in heating the propellant fluid by nuclear energy are discussed. Two possibilities are considered, viz.: (*a*) the solid reactor, in which the propellant is pumped through suitable channels in a nuclear reactor, receiving energy by surface heat transfer, and (*b*) the gaseous reactor, in which propellant and nuclear fuel are mixed in a gaseous state under such conditions of temp., pressure and fuel concentration that a chain reaction occurs. In the former case possible sizes of fast and thermal neutron systems are estimated from available data. The masses of unshielded reactors are not excessive, but the limitation set on max. propellant temp. by the melting points of reactor materials is a serious drawback, as is the problem of the power required to pump the propellant through the reactor. These difficulties would be eliminated in the gaseous reactor. The conditions for sustaining a reaction in gaseous mixtures of U^{235} with H and U^{235} with D are considered. In both cases the conditions for a chain reaction appear impossible, calling for prohibitive chamber pressures or dimensions.

L. R. S.

539.17 : 521 : 629.19

2708. The atomic rocket. IV. SHEPHERD, L. R. AND CLEAVER, A. V. *J. Brit. Interplan. Soc.*, **8**, 59–70 (*March*, 1949).—Although nuclear reactions are sufficiently energetic to produce exhaust velocities $\sim 10^3\times$ those possible by the methods outlined above, such high velocities could not be employed in rockets moving against the earth's gravitational field because of the excessive power dissipation. For vehicles moving in free space, however, it would be permissible to use very low propulsive thrusts and very high exhaust velocities ($\geqslant$ 100 km/sec) might then be employed. The most probable method of obtaining the desired exhaust velocities would be the acceleration of ions in electrostatic fields. A quantitative discussion indicates that heavy ions and comparatively high accelerating voltages would be preferable in order to limit the ion currents. Ions of both signs would have to be ejected to maintain electrical neutrality and waste heat would have to be discarded by radiation. The conversion of energy released in the nuclear reactor into electrical energy for accelerating the ions would prove a major problem as existing generation techniques would be completely inadequate. A possible solution might lie in direct conversion of nuclear into electrical energy. L. R. S.

539.17 : 537.534.74

The penetration of atomic particles through matter. *See Abstr.* 2554

539.17 : 537.591.8

2709. Origin of cosmic ray stars. GEORGE, E. P. Letter in *Nature, Lond.*, **162**, 333 (*Aug.* 28, 1948).—It is shown that provided the absorption of the star-producing radiation is that measured for single tracks by Perkins [Abstr. 992 (1948)], it may be interpreted as an absorption with cross-section = nuclear area. On this assumption the range of the star primaries in emulsions may be used to estimate the intensity of the primaries. At Jungfraujoch this $\simeq 12\%$ of the charged particle intensity, and is $\simeq$ the fast neutron intensity. J. G. W.

539.17 : 539.152.1

2710. On the penetration of nucleons through heavy nuclei. ZWANIKKEN, G. C. J. *Physica, 's Grav.*, **14**, 530–41 (*Dec.*, 1948) *In English.*—The rate of loss of energy of a nucleon traversing a nucleus and the mechanism of star production are investigated on the basis of the meson type of interaction $\varepsilon^{-\varkappa r}/\varkappa r$. The theoretical predictions are compared with the available empirical data. A.

539.17 : 539.185

2711. Total cross sections of nuclei for 90-Mev neutrons. COOK, L. J., MCMILLAN, E. M., PETERSON, J. M. AND SEWELL, D. C. *Phys. Rev.*, **75**, 7–15 (*Jan.* 1, 1949).—Total cross-sections of H, D, Li, Be, C, N, O, Mg, Al, Cl, Cu, Zn, Sn, Pb and U for 90 MeV neutrons have been measured, using the 184 in cyclotron as a source and C discs as detectors. Experimental details are described, and a brief discussion of some of the theoretical implications of the results is given. A.

539.17 : 771.535.1

Influence of pH on the development of photographic plates loaded with borax or uranyl nitrate. *See Abstr.* 2851

539.17 : 771.535.1

The mechanism of fading of nuclear research plates. *See Abstr.* 2852

539.172 : 530.145

The transmutation of elementary particles. *See Abstr.* 2340

539.172 : 537.534.74

Angular distribution of 1 to 3·5 Mev deuterons scattered by deuterons. *See Abstr.* 2555

539.172.1

2712. Excited level in Li^7 from the $Li^6(d, p)Li^7$ and $Be^9(d, \alpha)Li^7$ reactions. BUECHNER, W. W., STRAIT, E. N., STERGIOPOULOS, C. G. AND SPERDUTO, A. *Phys. Rev.*, **74**, 1569–74 (*Dec.* 1, 1948).—An annular magnet has been used to determine the difference in energy of the particles from the $Be^9(d, \alpha)Li^7$ and $Li^6(d, p)Li^7$ reactions. These energies have been measured through a direct comparison with the α-particles from Po, and they serve to determine the energy of the level in Li^7 excited in these processes. The values obtained are 482 ± 3 keV for the $Be^9(d, \alpha)$ reaction and 483 ± 6 keV for the $Li^6(d, p)$ reaction. A.

539.172.1

2713. The angular distributions of the products of the D — D reaction: 1 to 3·5 Mev. BLAIR, J. M., FREIER, G., LAMPI, E., SLEATOR, W., JR. AND WILLIAMS, J. H. *Phys. Rev.*, **74**, 1599–601 (*Dec.* 1, 1948).—Cross-sections per unit solid angle for the reactions $H^2 + H^2 \rightarrow He^3 + n$ and $H^2 + H^2 \rightarrow H^1 + H^3$ have been measured at various angles for incident deuterons of energies from 1 to 3·5 MeV. The dependence of the cross-sections on angle is nearly the same for the two reactions, and it can be represented by an expression of the form $A(1 + B\cos^2\phi + C\cos^4\phi)$, where ϕ is the angle of observation in the centre of mass co-ordinate system. A increases from 4×10^{-27} cm² at 1 MeV to 6×10^{-27} cm² at 3·5 MeV; B decreases from approximately 1 at 1 MeV to −3·5 at 3·5 MeV; C increases from 1·5 at 1 MeV to 7 at 3·5 MeV. The total cross-sections for the two reactions are approximately constant at 10^{-25} cm² throughout this energy range. A.

539.172.1

2714. Evidence of a *p,d* reaction in carbon. PANOFSKY, W. K. H. AND PHILLIPS, R. Letter in *Phys. Rev.*, **74**, 1732–3 (*Dec.* 1, 1948).—Stacks of polystyrene (C_nH_n) foils were bombarded by 32 MeV protons from a linear accelerator, and the β^+ activity of C^{11}, from $C^{12}(p, pn)C^{11}$, counted as a function of depth in the stack. Using a single foil, and collecting the protons in a Faraday cup, the absolute cross-section for 32 MeV was found to be $(0{\cdot}075 \pm 0{\cdot}02)\times 10^{-24}$ cm². The threshold energy, determined from the second derivative curve of the excitation function (which is reproduced), was 18·5 ± 0·3 MeV. The threshold of $C^{12}(p, pn)C^{11}$ calculated from the C^{12}, C^{11} masses is 20·2 MeV. Thus the process $C^{12} \rightarrow C^{11}$ must be a (p, d) reaction, at least near the threshold. T. G. P.

539.172.1

2715. Differential cross section for reaction $D(d, n)He^3$ for 10 Mev bombarding energy. ERICKSON, K. W., FOWLER, J. L. AND STOVALL, E. J., JR. Letter in *Phys. Rev.*, **75**, 894 (*March* 1, 1949).—Gaseous D was bombarded by deuterons from a cyclotron. He^3 particles were measured from 40° to 100° in the c. of g. system, using a 10-channel kicksorter, and neutrons at 0° using the $Cu^{63}(n, 2n)Cu^{62}$ reaction. The total cross-section was 0·07 barn. B. R.

539.172.1 : 539.152.1

2716. Energy levels in sulfur nuclei. DAVISON, P. W. *Phys. Rev.*, **75**, 757–66 (*March* 1, 1949).—A study has been made of the p groups from the reaction of 3·22 MeV deuterons with S in the form, primarily, of H_2S gas. The following Q values have been assigned to the reaction $S^{32}(d, p)S^{33}$: 6·48, 5·69, 4·58, 4·31, 3·63, 3·33, 2·60, 2·33, 2·06, 1·78, 1·37, 0·85 and 0·18 MeV, corresponding to the ground state and twelve excited states of S^{33}. 4 of these groups have been investigated for p–γ-ray coincidences to confirm this assignment. The yield as a function of deuteron energy has been observed for the 6 highest energy groups and indication of the presence of some broad resonances found. A qualitative measurement of the variation with angle of relative yields of the groups has indicated a p intensity distribution that is symmetric for some groups and asymmetric for others. The cross-section for the reaction for 90° observation has been found to be 1·2 barns. The mass difference $S^{33} - S^{32}$ has been calculated to be 0·99963 mass unit. Two low intensity, high energy groups have been assigned to the reaction $S^{33}(d, p)S^{34}$ with Q values of 8·67 and 7·85 MeV. This, together with the above observation, leads to a value of 1·99691 for the mass difference $S^{34} - S^{32}$. A.

539.172.1 : 539.164

2717. Particle groups from the bombardment of aluminum by deuterons. POLLARD, E. C., SAILOR, V. L. AND WYLY, L. D. *Phys. Rev.*, **75**, 725–31 (*March* 1, 1949).—Targets of Al leaf 30 keV thick have been bombarded by deuterons and found to emit protons in 14 groups and α-particles in 4 groups. These correspond to levels in Al^{28} and Mg^{25}. The level spacing in Al^{28} appears to become somewhat less at excitation energies of 5 MeV, and the population of the highly excited states is greater. There appear to be 5 major groupings, each having a finer structure. Observation at 90° and 0° with respect to the incident deuterons shows a considerable variation in relative yield. In comparison with neutron scattering levels for the same nucleus, the spacing here observed is greater. This may be due to the adverse selection of groups of high angular momentum on account of the Coulomb barrier. The level spacing in Mg^{25} is approximately 0·8 MeV. From the maximum energy of the protons and α-particles the mass difference between Al^{28} and Al^{27} is found to be 1·00073 ± 0·00008, and between Mg^{25} and Al^{27} is 1·99619 ± 0·00006 mass units. A.

539.172.1 : 539.18

2718. Positive mesons produced by the 184-inch Berkeley cyclotron. BURFENING, J., GARDNER, E. AND LATTES, C. M. G. *Phys. Rev.*, **75**, 382–7 (*Feb.* 1, 1949).—Positive mesons produced by 380 MeV alpha-particles in the 184 in Berkeley cyclotron have been detected by means of photographic plates. The experimental arrangement is similar to that used for detecting negative mesons except that the plates are placed in a position to receive positive instead of negative particles from the target. Heavy positive mesons are observed to decay into secondary mesons in the manner described by Lattes, Occhialini and Powell. Relative numbers of positive and negative mesons coming from a target are found by placing plates symmetrically on opposite sides of the target. Preliminary results indicate that for a $\frac{1}{16}$ in C target there are about $\frac{1}{4}$ as many heavy positive mesons as heavy negative ones for meson energies of 2–3 MeV in the laboratory system. A.

539.172.1 : 771.531

2719. Stars in photographic emulsions initiated by deuterons. I. Experimental. GARDNER, E. AND PETERSON, V. *Phys. Rev.*, **75**, 364–9 (*Feb.* 1, 1949).—Photographic plates have been bombarded with deuterons in the 184 in Berkeley cyclotron, and a group of 1 200 stars in the emulsion has been studied. The group included 300 stars at each of the following energies: 35, 90, 130 and 190 MeV. At each of these energies the average number of prongs per star was close to 3·0. About 3 times as many prongs were observed in the forward direction of the beam as in the backward direction. The study was made with desensitized plates, which do not show tracks of high energy protons. The results are to be interpreted as including all α-particles and heavier nuclear fragments but only the lower energy protons. A.

539.172.1 : 771.531

2720. Stars in photographic emulsions initiated by deuterons. II. Theoretical. HORNING, W. AND BAUMHOFF, L. *Phys. Rev.*, **75**, 370–8 (*Feb.* 1, 1949).—The theory of high energy nuclear stars depends on a theory of nuclear transparency and on a theory of nuclear evaporation. The transparency can be computed on the basis of a model proposed by R. Serber as soon as the interactions between the nucleons and the incident particle are known. The evaporation can be computed on the basis of the statistical model of the nucleus as soon as the nuclear entropy and binding energies of the evaporated particles are known. With approximate values for the above interactions, entropies, and binding energies, a probability distribution has been computed for the number of prongs per star. The results are in qualitative agreement with the observations on photographic emulsions described in I [Abstr. 2719 (1949)]. A.

539.172.1 : 771.531 : 539.164

2721. Stars in photographic emulsions initiated by alpha-particles. GARDNER, E. *Phys. Rev.*, **75**, 379–82 (*Feb.* 1, 1949).—A study has been made of stars in photographic emulsions initiated by α-particles from the 184 in Berkeley cyclotron. These stars are similar to stars initiated by deuterons, which were described in an earlier paper [Abstr. 2719 (1949)]. Eastman NTA plates were used. Plates from the emulsion number used will record α-particles of energy about 200 MeV and lower and protons of about 10 MeV and lower. The contribution of the high energy protons may be missing from the results given. The average number of prongs observed is close to 3. The ratio of the number of prongs in the 3 sectors in the forward direction of the beam to the number in the 3 backward sectors is about 6. The cross-section for the formation of stars has been estimated by counting sections of α-particle tracks and the stars associated with these tracks. For α-particles of energy 130 MeV the cross-section, averaged over all of the atoms in the emulsion, is 3×10^{-25} cm² with an estimated uncertainty of 30%. A.

539.172.11 : 539.164

2722. Yields of the platinum group radio-isotopes in the high energy helium-ion bombardment of uranium. WOLFE, R. D. AND BALLOU, N. E. Letter in *Phys. Rev.*, **75**, 527–8 (*Feb.* 1, 1949).—Natural U was bombarded with 380 MeV α-particles. The yields of Ru, Rh and Pd were ~ 500× those of Os, Ir and Pt, and ~ equal to that of Ba^{140}. It is concluded that there is no dip in the middle of the fission-yield curve. B. R.

539.172.13

2723. Disintegration of separated isotopes of magnesium by deuterons. ALLAN, H. R., WILKINSON, C. A., BURCHAM, W. E. AND CURLING, C. D. Letter in *Nature, Lond.*, **163**, 210 (*Feb.* 5, 1949).—Separated Mg isotopes have been bombarded with 930 keV deuterons, and the emitted protons observed normal to the incident beam, with the following results: $Mg^{24}(d, p)Mg^{25}$ ($Q = 5{\cdot}03$ MeV); excited states of Mg^{25} at 0·58 and 0·98 MeV; Mg^{25}: no reaction; $Mg^{26}(d, p)Mg^{27}$ ($Q = 4{\cdot}21 \pm 0{\cdot}1$ MeV). The reaction $Mg^{26}(d, \alpha)Na^{24}$ was also confirmed. [See also Abstr. 2571 (1948)]. A. O. S.

539.172.3

2724. Photodisintegration of deuterium and beryllium by thorium C″ γ-rays. ALLAN, D. L. AND POOLE, M. J. Letter in *Nature, Lond.*, **162**, 373–4 (*Sept.* 4, 1948).—A RdTh source was placed at the centre of a sphere of Be or D_2O immersed in a water tank. The integrated slow neutron density in the tank was obtained using Mn detectors. The ratio of cross-sections for (γ, n) disintegration in Be and D respectively was found to be $0{\cdot}35 \pm 0{\cdot}01$ (γ-ray energy = 2·62 MeV). This figure was checked using a long counter (energy-independent neutron detector) instead of a water tank to compare the neutron fluxes. Agreement with other workers is good [Abstr. 1917 (1948)]. A. P. F.

539.172.3

2725. Thresholds for several photo-nuclear reactions. MCELHINNEY, J., HANSON, A. O., BECKER, R. A., DUFFIELD, R. B. AND DIVEN, B. C. *Phys. Rev.*, **75**, 542–54 (*Feb.* 15, 1949).—The X-rays from a 22 MeV betatron were used to observe the thresholds for 23 photo-nuclear reactions. The observed thresholds are compared with the mass data for the lighter elements and with those obtained from an empirical treatment of the masses for the heavier elements. The excitation curves were extended up to 21 MeV in a few cases. These curves were very much alike except that for the Ta(γ, n) reaction. This curve showed an abrupt decrease in slope at about 18 MeV which indicates a much reduced cross-section for photons above this energy. A.

539.172.3 : 539.166

2726. 88-Mev gamma-ray cross sections. LAWSON, J. L. *Phys. Rev.*, **75**, 433–43 (*Feb.* 1, 1949).—Total cross-sections for 88 MeV γ-rays have been measured in 6 elements by absorption methods to a statistical accuracy of about 1·5%. The results expressed in cm²/g are 0·0107, 0·0252, 0·0471, 0·0665, 0·0909 and 0·0973 for the elements Be, Al, Cu, Sn, Pb and U, respectively. Values appear generally < predictions of existing theory by a factor proportional to Z^2. Ratios of pair formation cross-sections in different elements have been obtained in a few cases; these data can be used together with the total cross-section to obtain non-pair cross-sections (presumably Compton scattering). The cross-section so obtained at

8 MeV agrees within the experimental accuracy of bout 15% with the Klein–Nishina prediction for Compton scattering. A.

539.172.4

2727. Angular dependence of coincidences between fission neutrons. DeBenedetti, S., Francis, J. E., Jr., Preston, W. M. and Bonner, T. W. *Phys. Rev.*, **74**, 645–9 (*Dec.* 1, 1948).—Coincidences between the neutrons from *n*-induced fission of U^{235} were measured using fast neutron counters, working on the principle of proton recoil. From measurements at angles of 30°, 60°, 90°, 135° and 180° between the directions of the fission neutrons, it was found that the number of coincidences is fairly constant from 30° to 90°, and increases by ~ 2 from 90° to 180°. This result can be explained if it is assumed that the fission neutrons come from opposite fragments. A.

539.172.4

2728. Operational characteristics of the Harwell piles. Dunworth, J. V. *Research, Lond.*, **2**, 73–8 (*Feb.*, 1949).—A descriptive article giving a brief review of the development of atomic piles and some of the difficulties involved in the design of a pile and in its experimental applications. R. B. S.

539.172.4

2729. Relative cross sections for nuclear reactions induced by high energy neutrons in light elements. Knox, W. J. *Phys. Rev.*, **75**, 537–9 (*Feb.* 15, 1949).—Various light elements from C to S were bombarded in the high energy (about 90 MeV) neutron beam of the 184 in cyclotron and decay curves were taken on the resulting activities. Relative cross-sections for certain reactions were obtained by analysing the decay curves into component activities and comparing the yields with the activity induced in a C monitor bombarded in the same beam. Values for 16 reactions are given with a probable error of about ±10%, as well as upper limits for 6 other reactions. An apparent regularity among these data is pointed out; cross-sections for reactions differing by the ejection of an α-particle or its components differ by a factor of about 3. A.

539.172.4

2730. A cloud-chamber study of the disintegration of lithium by slow neutrons. Bøggild, J. K. and Minnhagen, L. *Phys. Rev.*, **75**, 782–5 (*March* 1, 1949).—The ranges of tritons and α-particles formed in the slow neutron reaction $Li^6(n,\alpha)H^3$ have been measured in a cloud chamber and found to be $R_\alpha = 10{\cdot}4 \pm 0{\cdot}2$ mm and $R_{H^3} = 60{\cdot}0 \pm 0{\cdot}6$ mm in air at N.T.P.; the corresponding Q values, derived from energy *v.* range curves, disagree, and the Q derived by the proton relation is also in disaccordance with other data. The discrepancies suggest the establishment of a new point on the proton energy *v.* range curve, viz. $R_p = 20{\cdot}0$ mm, $E_p = 0{\cdot}88$ MeV, which means a reduction of the energy by about 6%. A.

539.172.4

2731. Thresholds for fast neutron fission in thorium and uranium. Shoupp, W. E. and Hill, J. E. *Phys. Rev.*, **75**, 785–9 (*March* 1, 1949).—The threshold energy for fast neutron fission of Th and U has been measured by using the neutrons from thin Li films through the $Li^7(p,n)$ reaction. Neutron energy fission thresholds were found to be $1{\cdot}0 \pm 0{\cdot}1$ MeV for U^{238} and $1{\cdot}10 \pm 0{\cdot}05$ MeV for Th^{232}. [1941 work, now declassified.] A.

539.172.4 : 539.164

2732. The fission of thorium with alpha-particles. Newton, A. S. *Phys. Rev.*, **75**, 17–29 (*Jan.* 1, 1949).—The fission distribution of Th by α-particles of average energy 37·5 MeV has been measured by the chemical method. The distribution found shows that the characteristic dip in the fission yield mass spectrum has been raised to within a factor of 2 of the peaks compared to a factor of 600 in slow neutron fission of U^{235}. The raise in the dip has caused a corresponding lowering in fission yield of these elements at the peaks. The cross-section for fission of Th with 37·5 MeV α-rays was ~0·6 barn, and the threshold for fission was found to be 23–24 MeV. A.

539.172.4 : 539.18

Cloud chamber photographs of artificial mesons. *See Abstr.* 2738

539.172.4 : 539.185

2733. Slow-neutron capture in helium. Batchelor, R., Eppstein, J. S., Flowers, B. H. and Whittaker, A. Letter in *Nature, Lond.*, **163**, 211–12 (*Feb.* 5, 1949).—The (n,p) cross-section σ for thermal neutrons in He^3 was found by counting the protons produced in a chamber filled with atmospheric He, when subjected to a neutron flux, and performing a similar measurement after filling the chamber with A + a known amount of N_2. Assuming the thermal neutron σ of N^{14} to be 1·7 barns, and taking $2{\cdot}5.10^{-6}$ as the He^3 content of atmospheric He, σ for He^3 was found to be 3 700 ± 250 barns. A. P. F.

539.172.4 : 542.2

2734. Chemistry and atomic energy. Spence, R. *Research, Lond.*, **2**, 115–19 (*March*, 1949).—A lecture dealing with the chemical problems arising in atomic energy technology particularly in respect of new elements and their separation and analysis, and of the behaviour of materials in the presence of ionizing radiations. W. R. A.

ATOM AND MOLECULE BEAMS . MESONS NEUTRONS 539.18

539.18

2735. A model for nuclear capture of μ-mesons. Rosenbluth, M. N. Letter in *Phys. Rev.*, **75**, 532 (*Feb.* 1, 1949).—The assumption that in negative meson capture most of the energy is carried off by a light neutral particle is developed. On the further assumptions that the neutral particle is of zero mass, that the momentum of the incident meson may be neglected, and that the capturing nucleus contains equal numbers of protons and neutrons, the excitation of the nucleus arising from the recoil of the capturing nucleon leads to the probable emission of one neutron per capture. J. G. W.

539.18

2736. The emission of radiation in the disintegration of mesons. Feer, D. B. *Phys. Rev.*, **75**, 731–4

(*March* 1, 1949).—The probability has been calculated that a meson of integral spin disintegrates into an electron, a neutrino and a photon. This is essentially a classical process, the radiation being regarded as caused by the acceleration of charge in the disintegration. Because of the classical nature of the problem, the result is independent of the quantum mechanical properties (spin, coupling) of the meson field. For definiteness, the non-radiative decay is taken as being a two-body process in accordance with the original Yukawa theory, but several different types of couplings are used. The quantum mechanical probability for emission of one photon diverges at the low frequency end of the spectrum; this difficulty is avoided by using as a measure of the process the ratio of mean energy emitted to mean energy available for the process per unit time. This is of order $e^2/\hbar c$; the energy spectrum also is in agreement with the classical result. A.

539.18

2737. Production of mesons by electrons. SNEDDON, I. N. AND TOUSCHEK, B. F. Letter in *Nature, Lond.*, **163,** 524 (*April* 2, 1949). Correction, *ibid.*, **163,** 597 (*April* 16, 1949).—The cross-section for the process $e + P \rightarrow e' + P' \rightarrow e' + N + \pi^+$ (and the analogous $e + N \rightarrow e' + P + \pi^-$) is found to be $\sim 10^{-33}$ cm^2 for production of a vector meson at an electron energy ~ 300 MeV. These single nucleon cross-sections are to be multiplied by factors $\sim Z$ for +ve mesons, $\sim (A - Z)$ for −ve mesons, to give the cross-section for meson production in a nucleus (A, Z), so that values of $\sim 10^{-31}$ cm^2 may be attained with heavy nuclei. A. P. F.

539.18 : 530.14

Elementary particles and the principle of reciprocity. *See Abstr.* 2331

539.18 : 537.591.1

The mass of cosmic-ray mesons. *See Abstr.* 2581

539.18 : 537.591.15

The nature of mesons in penetrating showers. *See Abstr.* 2592

539.18 : 539.165

Electron-neutrino angular correlation in the beta-decay of He^6. *See Abstr.* 2682

539.18 : 539.172.1

Positive mesons from Berkeley cyclotron. *See Abstr.* 2718

539.18 : 539.172.4

2738. Some preliminary cloud-chamber photographs of artificial mesons. HARTSOUGH, W., HAYWARD, E. AND POWELL, W. M. Letter in *Phys. Rev.*, **75,** 905–6 (*March* 1, 1949).—Mesons of about 3 MeV energy have been observed in a cloud chamber traversed by the neutron beam arising from the impact of 350 MeV protons on a 2 in Cu sheet. These proceed from the cloud chamber walls, and an example of the capture of a negative meson (probably in A) with the emission of 2 heavy particles is given. J. G. W.

539.181 : 537.56 : 537.533.92

Ionization of KI, NaI and CsCl molecules by electrons. *See Abstr.* 2567

539.181 : 542.7

Glass diaphragm leaks for mass spectrometer analysis. *See Abstr.* 2792

539.185

2739. Milne problem in a multiplying medium with a linearly anisotropic scattering. DAVISON, B. *Nat. Res. Counc. Can.* (*No.* 1636) 71 *pp.* (*June* 11, 1946).—The neutron diffusion problem is treated for a semi-infinite medium such that the probability of scattering through θ into solid angle $d\Omega$ in a collision is given by $c(1 + 3b \cos\theta)d\Omega/4\pi$, where b and c are constants. ($c = 1$ for a non-absorbing non-multiplying medium.) A unique solution exists for the physically significant case of $3b(c - 1) < 1$; two linearly independent solutions arise for $3b(c - 1) > 1$. Both cases are worked out analytically, but a numerical evaluation is carried out only for the former. Values of the mean cosine of the angle of emergence of neutrons from the surface, of mean (cosine)^2 and of extrapolation length are tabulated as functions of b and c. [See also Abstr. 2655, 3668 (1947)]. A. P. F.

539.185

2740. On the scattering of thermal neutrons. NUYENS, M. AND GROSJEAN, C. *C.R. Acad. Sci., Paris,* **220,** 245–6 (*Jan.* 17, 1949) *In French.*—An analytic expression is obtained for the probability that thermal neutrons from a point source in a capturing and isotropically scattering medium shall undergo their nth elastic collision at a given distance from the source. A series development for the same result is given. A. P. F.

539.185

2741. Experiments on *N–P* scattering with 90- and 40-Mev neutrons. HADLEY, J., KELLY, E., LEITH, C., SEGRÈ, E., WIEGAND, C. AND YORK, H. *Phys. Rev.*, **75,** 351–63 (*Feb.* 1, 1949).—Measurements of the n–p scattering cross-section at neutron energies ~ 40 and 90 MeV are described. Both the total scattering cross-section and the differential cross-section as a function of the angle of scattering were measured. A.

539.185

2742. Spin dependence of slow neutron scattering by deuterons. FERMI, E. AND MARSHALL, L. *Phys. Rev.*, **75,** 578–89 (*Feb.* 15, 1949).—The cross-section of D gas at liquid air temperature for neutrons of average wavelength 5·43 Å is found to be $21{\cdot}3 \times 10^{-24}$ cm^2 per molecule. The cross-section of D atoms for neutrons of a few volts is found to be $3{\cdot}44 \times 10^{-24}$ cm^2 per atom. These two values are used to obtain information on the spin dependence of the neutron scattering by the deuteron. It is found that the two scattering lengths a_4 and a_2, corresponding to neutron spin parallel or anti-parallel to the deuteron spin, have the same sign but may differ in magnitude by as much as a factor 2. A.

539.185

2743. Laplace transform solution of two-medium neutron-ageing problem. BELLMAN, R., MARSHAK, R. E. AND WING, G. M. *Phil. Mag.*, **40,** 297–308 (*March*, 1949).—A point source of mono-energetic fast neutrons is situated at a given height above the interface between 2 semi-infinite plane media of different slowing-down properties. The equations for the slowing-down densities are solved by a Laplace transform method. The results are complicated, but certain simplifications are possible in some cases of physical importance. These are discussed in detail. L. S. G.

539.185

2744. Neutron-proton and neutron-neutron scattering at high energies. ROHRLICH, F. AND EISENSTEIN, J. *Phys. Rev.*, **75**, 705–24 (*March* 1, 1949).—The phase method and the Born approximation are used to calculate the cross-sections (σ) of high energy neutrons scattered by protons and neutrons. Various exchange theories are considered for both central and tensor forces of rectangular and Yukawa well shape. For the tensor case the phase method leads to general formulae for the differential and total σ's in terms of real phase shifts. The reality of the phase shifts is a direct consequence of the use of the asymptotic form of the eigenfunctions of the tensor force Hamiltonian. The differential σ in this case also contains the "amounts of admixture" which measure the coupling of states of different orbital angular momentum which have the same total angular momentum and the same parity. The real phase shifts and the amounts of admixture are derived from a variational principle. The total σ's thus obtained are within a few % of the exact values. The Born approximation is not satisfactory at 100 MeV. At this energy, tensor forces of a rectangular well shape with Rarita–Schwinger constants yield 0·2113, 0·1497 and 0·1271 barn for the *n-p* σ, and 0·2566, 0·1381 and 0·0359 barn for the *n-n* σ, in the neutral, charged, and symmetrical exchange theory, respectively. The observed *n-p* σ at 90 MeV, 0·083 ± 0·004 barns, agrees best with the theoretical value of ~ 0·080 barns at 100 MeV, derived from a tensor interaction potential of equal amounts of neutral and charged exchange. It is concluded, however, that a Yukawa tensor potential of the symmetrical exchange type can be in agreement with the experiments, if relativistic corrections of the *n-p* σ at 100 MeV are negative and of the order of 5–10%. The differential σ needs considerably larger corrections unless a different tensor force range is used. A.

539.185

2745. On the space distribution of slow neutrons. WICK, G. C. *Phys. Rev.*, **75**, 738–56 (*March* 1, 1949).—The behaviour of the neutron density about a plane- or point-source of fast neutrons within a homogeneous slowing-down medium has been re-investigated. For the case of constant mean free path a known analytical expression for the neutron density has been reduced to a form which is valid for slow neutrons and for any distance from the source. The feasibility of a numerical evaluation of the formula is demonstrated for $M = 1$ (hydrogen). In particular, the asymptotic behaviour at very large distances has been studied. For the more realistic example of a medium in which the mean free path decreases with decreasing energy of the neutrons, formulae are presented describing the asymptotic density and the asymptotic energy spectrum at large distances from the source. A.

539.185

2746. On the absorption of slow neutrons by rhodium. MEIJER, R. R. *Phys. Rev.*, **75**, 773–81 (*March* 1, 1949).—The absorption of neutrons in Rh as a function of their time of flight was studied with the Cornell slow neutron velocity spectrometer in the energy range of 0·0044 to 330 eV. A resonance was observed at an energy of 1·21 ± 0·02 eV. No other resonances were observed. Values of the Breit-Wigner parameters, which seem to fit the experimental results best for a resonance energy of 1·21 eV, are 2 750 ± 200 barns for the cross-section at resonance (σ_r) and 0·21 ± 0·01 eV for the level width (Γ). The Breit-Wigner formula fits the experimental data in the low energy region. The coefficient of the $1/v$ term is 0·295 ± 0·005 barn/μsec/m and the constant term (taken as the scattering cross-section) is 6 ± 2 barns. Values for the strength of the resonance ($\sigma_r\Gamma^2$) were computed from the minimum cross-section on the low energy side of the resonance, from the $1/v$ slope, from an activity plot, and from the chosen Breit-Wigner parameters. The average of these values of $\sigma_r\Gamma^2$ is 117 ± 8 barn-eV^2. Self-absorption measurements were made to check the results of the time-of-flight measurements. The resonance cross-section obtained from the self-absorption measurements is 3 120 ± 50 barns, which is in closer agreement with the results of the spectrometer measurements than with those of previous investigators. A.

539.185 : 537.13 : 530.145

Magnetic moment of the neutron. *See Abstr.* 2341

539.185 : 537.534.74

2747. Neutron-proton scattering at 90 Mev. BRUECKNER, K., HARTSOUGH, W., HAYWARD, E. AND POWELL, W. M. *Phys. Rev.*, **75**, 555–64 (*Feb.* 15, 1949).—An experimental measurement of the angular distribution of protons scattered by neutrons in the neutron beam of the 184 in Berkeley cyclotron has been made with a Wilson cloud chamber with magnetic field. The results show that the scattering is not isotropic in the centre of mass systems and that it is not symmetric about 90 deg. The peak of protons in the forward direction indicates that a certain amount of charge exchange is taking place between the neutron and proton. A.

539.185 : 537.591.8

Neutron production by cosmic rays at sea level. *See Abstr.* 2597

539.185 : 538.245

2748. Magnetic refraction of neutrons at domain boundaries. HUGHES, D. J., BURGY, M. T., HELLER, R. B. AND WALLACE, J. W. *Phys. Rev.*, **75**, 565–9 (*Feb.* 15, 1949).—In the course of experiments on the production of polarized neutrons, small-angle scattering (~ minute) of neutrons in unmagnetized Fe was observed. Further detailed experiments on the angular distribution, and variation with Fe thickness, of the scattering have been performed. The results are compared with theory and are shown to be consistent with the hypothesis that the scattering is caused by magnetic refraction of the neutrons at domain boundaries. A.

539.185 : 538.245

Polarization of neutrons in ferromagnetic domains. *See Abstr.* 2617

539.185 : 539.152.1 : 537.133

Non-central interactions between neutron and proton. *See Abstr.* 2653

539.185 : 539.17

Nuclear cross-sections for 90-Mev neutrons. *See Abstr.* 2711

539.185 : 539.172.4

Slow neutron capture in helium. *See Abstr.* 2733

STRUCTURE OF SOLIDS 539.2

539.215.2 : 539.4.016

2749. Cold working of aluminium at low temperatures. HUTCHISON, T. S. Letter in *Nature, Lond.*, **162**, 374–5 (*Sept.* 4, 1948).—Aluminium cold-worked at −180°c shows lattice distortion, which disappears during recrystallizing on return to room temperature. The broadening of the lines in X-ray back reflection is > that calculated assuming the fine grain effect (the Scherrer formula) to be operative, and the lower limit crystal size to be $\sim 10^{-4}$ cm. It is suggested that mechanical strain must exist.

A. J. K.

539.217.1

2750. Dependence of the setting and properties of powdered materials on their density (porosity). BALSHIN, M. YU. *J. Tech. Phys., USSR*, **18**, 1179–84 (*Sept.*, 1948) *In Russian.*—The linear dependence of the fritting on the density (porosity) found previously has not the character of a universal law and refers to special cases only within a wide range of porosities (up to 60%). For most of the practically important powders there is rather a near-linear dependence of the porosity reduction at fritting on the initial porosity. The same relations were found to apply to multiple-phase powders as to single-phase ones. Some empirical formulae were established. An explanation is presented of the relations between fritting, growth and mechanical properties on one hand, and porosity on the other hand. Deviations from these relations are usually due to the presence of oxides in the powdered materials. B. F. K.

539.23 : 537.311.1

The resistivity of thin metallic films. *See Abstr.* 2509

539.23 : 541.135.5 : 531.717

2751. Thickness of inhibiting films on glass electrode surfaces. HUBBARD, D. AND RYNDERS, G. F. *J. Res. Nat. Bur. Stand., Wash.*, **41**, 163–8 (*Sept.*, 1948).—The thickness of voltage-inhibiting films produced on glass surfaces by heat treatment after leaching has been studied by means of the glass electrode and the interferometer. The glass electrode gave conspicuous voltage departures (errors) and alterations (swelling) of the surface that were just detectable by the interferometer. This corresponds to approximately 0·01 fringe, or 4× the unit cell dimension for cristobalite. The inhibiting effect of films of electric conductors, such as metallic Ag, has been qualitatively compared with the inhibiting effect of films prepared from electric non-conductors, such as petrolatum and silicone stopcock grease. A.

539.24 : 534.213 : 534.321.9

Absorption of ultrasonic waves by solids. *See Abstr.* 2386

539.26 : 548.734

Accuracy of stress-determination by the Debye–Scherrer method. *See Abstr.* 2802

539.26 : 621.74 : 620.179.15

2752. An X-ray method for studying skin thickness of bronze castings. LUTTS, C. G. *Non-Destr. Test.*, **6**, 13–14 (*Spring*, 1948).—Thin slices of metal ⅛ in thick are cut through the full cross-section of the casting and radiographed at 150 kV with extra fine grain film. It is shown that the surface layer of the casting is denser than the underlying metal. Radiographs of billets poured from a pot of metal at 2 200, 2 100 and 2 000°F show that a lower pouring temperature promotes a thicker skin. Knowing the thickness of the skin, the machining operation can be better planned than heretofore. T. A. C. (R)

539.264 : 548.73

2753. The X-ray measurement of the amorphous content of polythene samples. MATTHEWS, J. L., PEISER, H. S. AND RICHARDS, R. B. *Acta Cryst.*, **2**, 85–90 (*April*, 1949).—The method is based on a microphotometric comparison of the intensities of the amorphous band and the two strongest crystalline lines on X-ray powder photographs obtained from the samples in sheet form. Corrections for 2 types of orientation are described. The results indicate that amorphous contents at ordinary temperatures may vary from below 10% to above 50%, normal samples having an amorphous content of about 25%. The more amorphous samples have lower densities; the quantitative relation between density and degree of crystallinity is discussed. A.

539.27

2754. A positive-replica technique for electron microscopy. SCHWARTZ, C. M., AUSTIN, A. E. AND WEBER, P. M. *J. Appl. Phys.*, **20**, 202–5 (*Feb.*, 1949).—A positive-replica technique for electron microscopy has been developed, which reproduces the contour variations of the specimen surface, and permits direct visual interpretation of elevation. The method utilizes two resins, each mutually insoluble in the solvent for the other, specifically, polyvinyl alcohol plus Formvar. Shadow casting of the Formvar positive replica enhances detail and highlights the areas in relief in the original surface. Examples are given, in particular, applied to wear-test specimens. A.

539.27 : 541.64 : 541.14

2755. Electron microscopy of radiation polymerization products. WATSON, J. H. L. *J. Phys. Coll. Chem.*, **52**, 470–4 (*March*, 1948).—Acetylene polymerizes to give various products, of which three are described, viz. cuprene, formed by catalytic polymerization; alprene, by the action of α-particles; and coprene, formed in a corona discharge. Under the electron microscope, cuprene is fibrous, alprene consists of round particles joined in haphazard arrangements by short thick necks, and coprene is an almost structureless film. The detailed electron-microscope appearances of these substances are described and discussed. C. B. A.

ELASTICITY . STRENGTH . RHEOLOGY 539.3/.8

539.31 : 538.114

Irreversible magnetic effects of stress. *See Abstr.* 2600

539.32 : 537.228.1

Calculation of piezo-electric constants of α-quartz n Born's theory. *See Abstr.* 2503

539.32 : 669.018

2756. The elastic properties of metallic alloys. CABARAT, R., GUILLET, L. AND LE ROUX, R. *J. Inst. Met.*, **75**, 391–402 (*Feb.*, 1949).—A study of he effect of constitution on the elastic modulus and ogarithmic decrement in Cu–Sn and Cu–Zn alloys. he method employed consisted in setting up by lectrostatic means longitudinal vibrations in the pecimens, thereby submitting them to very small trains at a high frequency, all measurements being nade in free air. In the two systems, the δ and γ phases, which have multi-atomic cells, are shown to ave high moduli of elasticity with low values for he internal friction, whereas the curve showing the elationship between the latter property and the omposition shows maxima for the phases β (body-entred cubic) and ε (hexagonal). Changes of the decrement with composition follow closely those of he electrical conductivity. The experimental data are discussed in the light of current theory. A.

539.37 : 539.382

2757. Large deformations of an elastic solid. CHILTON, E. G. *J. Appl. Mech.*, **15**, 362–8 (*Dec.*, 1948).—Hencky's stress-strain relation for large deformations of a rubberlike material is reviewed and applied to the cases of pure tension, compression, bending, shear and torsion. Each case is verified experimentally with natural rubber samples. A.

539.373 : 548.4

2758. A grain boundary model and the mechanism of viscous intercrystalline slip. Kê, T'.-S. *J. Appl. Phys.*, **20**, 274–80 (*March*, 1949).—A study of the activation energy associated with the viscous intercrystalline slip shows that the conventional theories of grain boundary, e.g., the intercrystalline amorphous cement theory and the abrupt transitional theory, are both untenable. A grain boundary model is described in which the transition region at the boundary is considered as consisting of numerous disordered groups of atoms or diffused holes. The intercrystalline slip occurs through the atomic rearrangement by thermal agitation within each "disordered group" by a shear process involving as units of flow only a few atoms. This grain boundary model and slip mechanism are consistent with experimental facts and furnish, furthermore, a unified viewpoint as to the mechanism of the viscous intercrystalline slip, the volume diffusion in metals, and the constant rate creep of metal crystals under small stress. Further experiments are described concerning the influence of previous deformation and impurities on grain boundary viscosity. It has been found that the grain boundary viscosity is lower in a specimen subjected to a heavier deformation prior to its recrystallization. A very small amount of impurities was found to block partially or completely the grain boundary slip in Al, Fe and Cu. These observations are readily understood on the basis of the proposed grain boundary model and slip mechanism. A.

539.374

2759. Recent developments in the mathematical theory of plasticity. PRAGER, W. *J. Appl. Phys.*, **20**, 235–41 (*March*, 1949).—The first part of the paper is concerned with the general technique used in the discussion of stress-strain laws for inviscid elastic-plastic materials with work hardening. It is postulated that when the "mechanical state" of such a material is known a given infinitesimal change of stress produces a uniquely defined infinitesimal change of strain. Once the assumption is made as to which variables determine the mechanical state, the conditions of continuity, uniqueness, irreversibility, and consistency can be used to extract rather far-reaching information regarding the structure of the stress-strain law. The procedure is applied to the case where the mechanical state is determined by the components of stress and permanent strain. The second part is concerned with various problems of plastic equilibrium. Structural stability in the plastic range is discussed and the difficulties arising in the formulation of stability problems for non-conservative systems are pointed out. Statically determinate problems in the Saint-Venant–Mises theory of plasticity are reviewed with special reference to discontinuous solutions. Finally, the "shake-down" problem is discussed for an elastic-plastic structure under the action of loads, each of which varies in a random manner between given extreme values. A.

539.374 : 536.48

2760. Impact viscosity of metals at −253°C. KOSTENETS, V. I., LAZAREV, B. G., KHOTKEVICH, V. I. AND SHIKHMAN, M. G. *J. Tech. Phys., USSR*, **18** 1149–55 (*Sept.*, 1948) *In Russian.*—A method is given for the rapid determination of the impact viscosity of specimens at the temperatures of liquid N and H (−196 and −253°c). At these temperatures 3 types of metals were investigated, viz. Cu M-3, cast iron LS–62 and cast iron LS–59. B. F. K.

539.374 : 539.32

2761. On the influence of plastic deformation on the elastic modulus. LAURENT, P. AND EUDIER, M. *C.R. Acad. Sci., Paris*, **220**, 225–6 (*Jan.* 17, 1949) *In French.*—Quotes the observed change of elastic modulus of an Al–Cu alloy with time of plastic deformation, the value of the modulus falling initially and then increasing after ~0·20% extension. Suggested that the decrease is connected with the plastic flow mechanism, and the increase with a modification of the metal texture. A. J. K.

539.374 : 539.382

2762. On the impact behavior of a material with a yield point. WHITE, M. P. *J. Appl. Mech.*, **16**, 39–52 (*March*, 1949).—An analysis of longitudinal impact tests on an iron and a steel with definite yield points is described. The probable nature of the dynamic stress-strain relations for such materials is deduced. These appear to differ greatly from the static stress-strain relations, the upper yield stress for undeformed material being several times as great under impact as the static yield stress. The present analysis indicates that under impact, the material with a definite yield point is made harder at a given deformation, and ruptures at a higher (engineering) stress and smaller strain than when loaded statically. The critical impact velocity, defined as that at which nearly instantaneous failure occurs in tension, is

discussed, and the factors upon which it depends are given. A.

539.38

2763. Mechanical properties of vulcanised butadiene-styrol rubber in two-dimensional deformation. BARTENEV, G. M., DOGADKIN, B. A. AND NOVIKOVA, N. M. *J. Tech. Phys., USSR*, **18**, 1282–9 (*Oct.*, 1948) *In Russian.*—It is shown that in the 2-dimensional tensile stress case the higher theory of elasticity finds a wider scope of application than in the case of linear tension; this is due to "mechanical vulcanization" reducing the plasticity of the material. On stressing, a disruption of the local secondary bonds takes place, leading to irreversibility of contraction. The best opportunity of applying higher elasticity methods to 2-dimensional tension arises for rubbers containing $\leqslant 1{\cdot}5\%$ S. B. F. K.

539.382 : 539.374

Impact behaviour of material with a yield point. *See Abstr.* 2762

539.4 : 548.7

A dynamical model of a crystal structure. *See Abstr.* 2798–9

539.434 : 531.224

Bending of beams with creep. *See Abstr.* 2342

539.61 : 532.64

2764. Direct measurement of the force of adhesion in a solid-liquid interface. GUASTALLA, J. AND GUASTALLA, L. *C.R. Acad. Sci., Paris*, **226**, 2054–6 (*June* 21, 1948) *In French.*—The force of adhesion F is measured for a water-paraffin surface by immersing a paraffin-coated metal-block in water. A hysteresis curve is obtained in which the pull on the block is plotted against the depth of immersion for immersion and withdrawal. From the graph a correction is obtained for the upthrust of the liquid. The hysteresis of the angle of contact is explained by friction, this is confirmed by roughening the surface. The mean value of F is not affected by the state of the surface. F is equal to -27 dynes/cm. An insoluble film on the water or a wetting agent increases F, a film of oleic acid raises F to $+11$ dynes/cm. The method is suitable for the determination of the degree of wetting. R. A. W.

539.6

2765. On a new method of determining the dissipation of energy by internal friction in solids. L. ROLLAND, P. *C.R. Acad. Sci., Paris*, **227**, 37–9 (*July* 5, 1948) *In French.*—Describes a method in which the specimen is subjected to forced vibrations by two identical oscillating systems. The theory shows that measurement of the decrement when they are (1) in phase, (2) in antiphase, together with a count of the number of oscillations, N, between "stationary points," executed by one system starting from rest, the other being set in motion, is all that is required. Pendulums were used as the systems in the case discussed, the results showing that the difference of the two decrements is inversely $\propto N$ for the same material, as indicated by theory. A. J. K.

539.893 : 536.4

2766. The possibility of producing super-high pressures by thermal methods. KAN, YA. S. *J. Tech. Phys., USSR*, **18**, 1156–7 (*Sept.*, 1948) *In Russian.*—A brief discussion of methods, difficulties and results as well as of experiments in one of which the production of 20 000 atmospheres at 150°C is claimed although the vessel could not stand it. Working medium in this case was Hg. A thermodynamic cycle carried through in a 3-stage apparatus would theoretically produce pressures of at least 10 000 atm. using ethyl alcohol as medium, and in tests within a safe range of pressures easily produced the expected 3 500 atm. B. F. K.

PHYSICAL CHEMISTRY 541

541.1

2767. Physico-chemical methods. III. REILLY, J. AND RAE, W. N. *London, Methuen* (1948) *pp.* ix + 697, 310 *figs.*, 1 *plate.*—Deals with "borderline practical problems of interest to both the chemist and physicist." Subjects covered are: the electron microscope, photoelectric cells, fluorescence, determination of atomic and molecular weights, the mass spectrograph, diffusion, solutions, osmosis, reaction kinetics, surface tension, viscosity, adsorption, chromatography, colloids, emulsions, vacuum and laboratory techniques, explosive testing, spectroscopy, etc. Extensive lists of references for further reading are given.

PHASE EQUILIBRIUM 541.121/.123

541.122.2

2768. On the properties of paraffin wax in the solid state. MAZEE, W. M. *J. Inst. Petrol*, **35**, 97–102 (*Feb.*, 1949).—A description is given of the behaviour of some binary mixtures of pure hydrocarbons. It was found that a n-$C_{21}H_{44}$ and a n-$C_{23}H_{48}$ form a continuous series of mixed crystals whereas n-$C_{21}H_{44}$ and n-$C_{31}H_{64}$ form a eutectic so that n-$C_{21}H_{44}$ and n-$C_{31}H_{64}$ crystallize separately. A mixture of n-$C_{24}H_{50}$ and 13-methylpentacosane also gave a binary system with a eutectic. On the strength of these phenomena a hypothesis was formulated on the structure of commercial paraffin waxes. A.

541.123.3

2769. The system methylmethacrylate–methanol–water. KOOI, J. *Rec. Trav. Chim. Pays-Bas*, **68**, 34–50 (*Jan.*, 1949) *In English.*—The curves of partial miscibility of the system methylmethacrylate–methanol–water have been determined at 0°, 25° and 50°C, as well as the variation of the density at 25° along the curve of partial miscibility. A graph has been constructed on this basis, which gives the composition of the two coexisting phases of the system from the density of one of them. The critical solubility point

at 25°C is situated at 32·45% methanol, 38·50% methylmethacrylate and 29·05% water. A.

REACTION KINETICS 541.124/.128

541.126

2770. Low-order detonation in solid high explosives. TRANTER, T. C. Letter in *Nature, Lond.*, **162**, 335–6 (*Aug.* 28, 1948).—The low detonation velocities in crystalline TNT reported by Jones and Mitchell [Abstr. 1687 (1948)] are also found in confined cast TNT cylinders, the grain size being altered by changing the rate of cooling. A linear relation between $1/U^2$ and $1/R$ (U = detonation velocity, R = cylinder radius) is found for material cooled at the same rate. Results suggest that the "reaction time" of cast TNT is a function of grain size.

T. S. E. T.

541.126 : 536.46 : 536.423

Evaporation processes in a burning kerosene spray. *See Abstr.* 2471

ELECTROCHEMISTRY 541.13

541.13 : 621.928.3 : 621.352

2771. An apparatus for determining the effect of centrifugal force on the potentials of galvanic cells. RAY, B. R. AND MACINNES, D. A. *Rev. Sci. Instrum.*, **20**, 52–8 (*Jan.*, 1949).—An apparatus is described with which electric potentials, developed as a result of phenomena occurring in the rotor of a centrifuge, can be measured within 1 μV, and radial temperature differences in the rotor can be determined and controlled within 0·01°. Rotation in a vacuum minimizes the rise of temperature of the rotor, which can also be measured. The speed of rotation is controlled by a friction drive within 0·01% and maintained at definite values, between 400 to 7 200 r.p.m., corresponding to stroboscopic patterns. The instrument was designed to measure the effect of centrifugal fields on simple galvanic cells. A.

541.133 : 537.226.1

Electrolytes in solvents of low dielectric constant: the second Wien effect. *See Abstr.* 2498

541.135

2772. Frequency dependence of the capacity of a diffuse double layer. FERRY, J. D. *J. Chem. Phys.*, **16**, 737–40 (*July*, 1948).—The capacity is calculated to be inversely proportional to the square root of the frequency at frequencies high compared with the reciprocal of the relaxation time of the ionic atmosphere. This dependence is observed experimentally with inert electrodes in very dilute solutions, but at considerably lower frequencies. The observed capacity is probably concerned with phenomena at the immediate vicinity of the electrode rather than the diffuse double layer. A.

541.135.08

2773. An apparatus for the measurement of the conductivity of electrolytes. MONEYPENNY, H. K. *J. Sci. Instrum. Phys. Ind.*, **26**, 120–4 (*April*, 1949).—The measurement of the a.c. conductivity of an electrolyte by orthodox means requires the simultaneous establishment of resistive and reactive balances, of which only the former is of interest. The apparatus described provides a direct measure of the resistive component by making use of the boundary conditions between stability and instability in an amplifier in which the actual measuring bridge provides a feed-back network. The transition from quiescence to oscillation is governed by the resistive balance condition only: visual indication of the transition is provided and the apparatus can be made direct-reading. Temperature compensation is provided by means of a thermistor, and the application to problems of chemical analysis is indicated. A.

541.135.5 : 531.717 : 539.23

Thickness of inhibiting films on glass electrode surfaces. *See Abstr.* 2751

541.135.5 : 536.7

2774. Entropy, enthalpy, and free energy of the electrical double layer at an ideal polarized electrode. I. Thermodynamic theory. GRAHAME, D. C. *J. Chem. Phys.*, **16**, 1117–23 (*Dec.*, 1948).—Several kinds of entropy, enthalpy and free energy changes are associated with the electrical double layer. Definitions of the thermodynamically significant quantities are given, together with equations for their evaluation. It is shown that the ideal polarized electrode may be regarded as one electrode in a galvanic cell and that the usual thermodynamic treatment of cells may be applied. The electrochemical process occurring in such a cell is identified, and a method of evaluating a new property, the transference number of the ions of the double layer, is given. The relationship between electrocapillary properties of metals and the thermodynamic properties of colloids is indicated. The thermodynamics of gas adsorption on solids is presented as an aid to the interpretation of the above. A.

PHOTOCHEMISTRY 541.14

541.14

2775. Radiation chemistry of aqueous solutions. ALLEN, A. O. *J. Phys. Coll. Chem.*, **52**, 479–90 (*March*, 1948).—The decomposition of pure water into H and OH radicals by ionizing radiations, and the effects on it of simple solutes, are discussed in the light of experiments with ionizing particles of high energy (1 MeV electrons, tritium β's, 8 MeV deuterons and pile radiation). Hydrogen is to be expected in the products of radiolysis of pure water; statements that pure water is not affected by X-rays may be ascribed to a failure to detect the very low pressure of H_2 generated. Steady state pressures of H_2 for various radiations are tabulated and discussed.

C. B. A.

541.14

2776. The existence of free atoms and radicals in water and aqueous solutions subjected to ionizing radiation. DAINTON, F. S. *J. Phys. Coll. Chem.*, **52**, 490–517 (*March*, 1948).—The processes occurring in

water, vapour and liquid, during the passage of ionizing radiations through it, are considered in the light of available data, and the kinetics of radiolysis of pure H_2O and of indirect action on solutes are discussed. The conclusions are in accordance with the current hypothesis that free OH and H radicals are formed. At low solute concentrations, H_2 and H_2O_2 may be expected among the products. Preliminary results on the polymerization of nitriles induced by X- or γ-rays, or by photosensitization with H_2O_2, are in accordance with the theoretical considerations. See also Abstr. 2775 (1949). C. B. A.

541.14

2777. Transformation of organic substances by alpha-particles and deuterons. BREGER, I. A. *J. Phys. Coll. Chem.*, **52**, 551–63 (*March*, 1948).—Results of a general programme of research on the effects of radiations from radioactive sources on fatty and naphthenic acids, made at the Massachusetts Institute of Technology, are reviewed. Fatty acids can be converted into aliphatic components of crude oil, and naphthenic acids into the alicyclic components. [For details, see also Abstr. 243, 1687 and 1688 (1946), and 418 and 419 (1947)]. C. B. A.

541.14

2778. Radiation chemistry. IV. An interpretation of the effect of state on the behavior of some organic compounds and solutions. BURTON, M. *J. Phys. Coll. Chem.*, **52**, 564–78 (*March*, 1948).—The processes occurring during radiolysis of some organic compounds are reviewed from the following aspects:—the effects of size of the bombarding particle and of state of the compound on the primary processes; the effect of state and of the type of compound on the secondary processes. The behaviours of excited molecules and of ions are considered. In particular, benzene is compared with other hydrocarbons; its low reactivity is attributable in part to its photochemical stability and in part to the stability of the $C_6H_6^+$ ion. Future lines of research are suggested. C. B. A.

541.14

2779. Photo-chemical studies. XL. The mechanism of the photo-chemical decomposition of acetone. NOYES, W. A., JR., AND DORFMAN, L. M. *J. Chem. Phys.*, **16**, 788–97 (*Aug.*, 1948).

541.14 : 535.343.32

Photo-chemistry of ions in solution. *See Abstr.* 2432

541.14 : 537.531 : 539.164

2780. Formation of hydrogen peroxide in water irradiated with X- and alpha-rays. BONET-MAURY, P. AND LEFORT, M. *Nature, Lond.*, **162**, 381–2 (*Sept.* 4, 1948).—The radiation chemistry of water is investigated with X-rays of 0·9 Å and α-rays from Rn or Po, with the following results. Effect of dissolved O_2:—The production of H_2O_2 by X-rays depends markedly (but not linearly) on the concentration of O_2. No H_2O_2 is detected in the complete absence of O_2 with X-rays, but with α-rays the ionic yield is the same as for oxygen-saturated water. Effect of temperature:—With X-rays, and oxygen-saturated water, the H_2O_2 yield decreases with falling temperature and ceases altogether at -116°C; but the production of H_2O_2 with α-rays from dissolved radon is independent of temperature. C. B. A.

541.14 : 537.533.9

2781. Controlled-electron reactions. GLOCKLER, G. *J. Phys. Coll. Chem.*, **52**, 451–6 (*March*, 1948).—The known gas reactions induced by bombardment with electrons of controlled energies are reviewed. The initial stages of the reactions can be interpreted on the basis of the quantum state of the interacting molecules as given by their energy level diagram. C. B. A.

541.14 : 537.542

Radiation chemistry of the G.M. counter discharge. *See Abstr.* 2565

541.14 : 537.56

2782. Chemical reactions produced by ionisation processes. HIRSCHFELDER, J. O. *J. Phys. Coll. Chem.*, **52**, 447–50 (*March*, 1948).—The chemical reactions produced by ionizing radiations in gases can be studied and understood in terms of a sequence of steps, for some of which the experimental data are already available; a general procedure is set out. The ionization and excitation processes lead to a collection of free radicals and atoms, the subsequent fate of which is the same as in photochemical reactions. C. B. A.

541.14 : 539.164

2783. The effect of electric fields on the decomposition of nitrous oxide by alpha-rays. WILLIAMS, N. T. AND ESSEX, H. *J. Chem. Phys.*, **16**, 1153–7 (*Dec.*, 1948).—Combinations of oppositely charged ions play no part in initiating the decomposition of N_2O by α-rays at 10 and 20 cm pressure. The decomposition in the absence of a field is evidently largely initiated by the splitting of molecules on electron collision. The application of electric fields above those required to attain $\frac{1}{2}$-saturation increases the ion yield because of the acceleration of free electrons by the fields. At higher field strengths the ion yield attains a value which remains unchanged on further increase in field strength. When the ion yield has this final constant value all electrons are attached to form negative atomic or molecular ions before reaching the electrode. Assuming the same reactions occur on electron collision as in the photo-chemical reaction, the increase in ion yield as a result of the effect of the field involves a minimum of 1·2 molecules of nitrous oxide split without attachment of the electron for each molecule split with attachment. A.

541.14 : 539.164 : 537.53

Oxidising and reducing effect of X- and α-radiations. *See Abstr.* 2681

541.14 : 539.167

Chemical effects in nuclear electron emission. *See Abstr.* 2698

541.14 : 539.169

2784. Reactions of carbon tetrachloride with bromine activated by isomeric nuclear transition and by the neutron-gamma reaction. WILLARD, J. E. *J. Phys. Coll. Chem.*, **52**, 585–94 (*March*, 1948).—The dependence on temp. and phase of the probability of reaction between activated Br and CCl_4 was measured. Various other disintegration and combination processes involving Br* were studied. The precise behaviour depends on whether activation is by

isomeric transition or by (n, γ) process. Formation of CCl_2Br_2 was observed in the latter case. Reaction mechanisms are proposed. A. P. F.

COLLOIDS . DISPERSE SYSTEMS 541.18/.182

541.18 : 535.55

Flow birefringence measurements on high-polymer solutions. *See Abstr.* 2460

541.182.4

2785. Oil/water emulsions: some physical factors which determine the type of emulsion. Dickinson, W. and Iball, J. *Research, Lond.*, **1**, 615–17 (*Oct.*, 1948).—Emulsions were made of an oil (cyclohexane and/or liquid paraffin) containing a monoglyceride (mono-olein) and an aqueous solution of a soap (sodium laurate). The following factors were studied: the relative amounts of the emulsifying agents, the phase volume ratio, the viscosity of the oil phase, and the method of dispersing one phase in the other. It is shown that all these factors play a part in determining whether the resulting emulsion is oil-in-water or water-in-oil and that either type can exist over a large range of phase volume ratios. J. I.

541.182.4 : 534.22.094.1

Propagation of sound in emulsions. *See Abstr.* 2393

541.182.6 : 532.133 : 532.77

Effect of particle size on viscosity of suspensions and solutions. *See Abstr.* 2352

541.182.6 : 534.321.9

2786. Division of the energy in a suspension subjected to ultrasonic waves. Dognon, A. and Simonot, Y. *C.R. Acad. Sci., Paris*, **220**, 230–1 (*Jan.* 17, 1949) *In French.*—Tests made with suspensions of paraffin and yeast, together with suitable colouring agents, indicate that the action of ultrasonic waves raises the temp. of the particles several degrees above the overall temp. of the suspension, showing that the greater part of the energy is absorbed by the particles and explaining why cavitation is retarded when the concentration of a dilute suspension is increased. G. F. H.

541.182.6 : 535.343.32

Infra-red Christiansen filter effect in slurries of organic crystals. *See Abstr.* 2433

ADSORPTION 541.183

541.183.02 : 537.562

2787. Ionization processes on tungsten filaments. II. The absorption of fluorine on tungsten. Metlay, M. and Kimball, G. E. *J. Chem. Phys.*, **16**, 779–81 (*Aug.*, 1948).—F is found to form an adsorbed film on W stable to temperatures above 2 600°K. This causes a low accommodation for the thermal dissociation of F. The adsorption is compared to that of O on W. A.

CHEMICAL STRUCTURE 541.4/.6

541.4 : 539.132

Theory of ammonium. *See Abstr.* 2640–1

541.5 : 539.132

Force constants in polyatomic molecules. *See Abstr.* 2642

541.5 : 539.133 : 535.343–15

Deformation vibrations of H atoms attached to a double bond. *See Abstr.* 2428

541.57 : 539.132

2788. The nature of bond orbitals in quadricovalent complexes of transition elements. Kuhn, H. *J. Chem. Phys.*, **16**, 727–33 (*July*, 1948).—In quadricovalent complexes of transition elements the central atom uses 4 *s* or *d* orbitals of its outer shell for unshared electron pairs and 2 *s* or *d* and 2 *p* orbitals for bond formation. The problem here is to find the strongest possible 4 hybrid bond orbitals obtained by combining the 2 $s - d$ and the 2 *p* orbitals available for bond formation. The strongest bond orbitals thus obtained are directed from the middle towards the 4 corners of a square, as is expected from experimental evidence; they are composed of 4/9 *s*, 14/9 *d*, and 2 *p* orbitals, the strength being 2·943. These strongest possible orbitals are presumably used in complexes of Ni^{II}, Pt^{II}, Au^{III} and Cu^{II}, but probably not in complexes of Pd^{II} and Ag^{II}; in the latter 2 cases square bond orbitals of composition $s^n d^{2-n} p^2$ must be assumed with *n* somewhere between 1 and 4/9, i.e. orbitals of character between that of the strongest square bond orbitals of composition $s^{4/9} d^{14/9} p^2$ mentioned above and that of sdp^2 square orbitals discovered by Pauling. A.

541.57 : 539.132

Wave mechanics of resonating organic molecules. *See Abstr.* 2643

541.6 : 534.22

Propagation of ultrasonic waves in solutions. *See Abstr.* 2392

541.6 : 535.34 : 535.6 : 535.33

Absorption spectra and chemical constitution of organic molecules. *See Abstr.* 2414

541.64 : 535.347 : 535.54

Polarized i.r. radiation as an aid to the structural analysis of long-chain polymers. *See Abstr.* 2436

541.64 : 539.133

Equation of state of linear macromolecules in layers. *See Abstr.* 2647

541.64 : 539.27 : 541.14

Electron microscopy of radiation polymerization products. *See Abstr.* 2755

541.64 : 541.14

2789. Benzene formation in the radiochemical polymerization of acetylene. Rosenblum, C. *J. Phys. Coll. Chem.*, **52**, 474–8 (*March*, 1948).—Benzene occurs in the radiochemical polymerization of acetylene simultaneously with the solid (cuprene-like) substances, about $\frac{1}{3}$ of the acetylene being so utilized. The ion-cluster theory of radiochemical polymerization is inadequate to explain the phenomena, and a mechanism based on a sequence of bimolecular

reactions between a normal acetylene molecule and an excited molecule or polymer is proposed. Benzene may result from the cyclization of a linear trimer.

C. B. A.

541.64 : 541.65 : 535.435

Scattering of light in high polymer solutions. *See Abstr.* 2456

541.65/.69 : 535.435

Light scattering in polystyrene solutions. *See Abstr.* 2457

541.67 : 538.22

2790. The magnetic susceptibilities of some uranium (IV) compounds. HUTCHISON, C. A. AND ELLIOTT, N. *J. Chem. Phys.*, **16**, 920–6 (*Sept.*, 1948).—Values for $U(SO_4)_2 \cdot 3{\cdot}26H_2O$, $U(C_2O_4)_2 \cdot 5H_2O$ and $U(C_5H_7O_2)_4$ have been determined at a series of temps. from the boiling point of liquid N to 60°C. The Weiss-Curie law is obeyed at temps. above 195°K. The data indicate the presence of two 5*f* electrons in the ground state. The susceptibility of $Th(C_5H_7O_2)_4$ at room temp. has also been determined. A.

541.67 : 538.22 : 539.133

2791. Diamagnetic susceptibilities of shared electrons. YANG, T.-Y. *J. Chem. Phys.*, **16**, 865–71 (*Sept.*, 1948).—By regarding the two shared electrons of a covalent bond as forming a doubly charged negative ion, and the molecule as consisting of positive and negative ions, one may, in some cases, assign diamagnetic susceptibilities to the constituent parts of the molecule. The values thus found are in good agreement with the experimental results. A.

CHEMICAL APPARATUS 542.1/.7

542.2 : 539.172.

Chemistry and atomic energy. *See Abstr.* 2734

542.7 : 539.18

2792. Construction of glass diaphragm leaks for gas analysis with a mass spectrometer. DIBELER, V. H. AND TAYLOR, T. I. *Science*, **108**, 686–8 (*Dec.* 17, 1948).—The construction of glass leaks for admission of gas by molecular flow is described in detail. One end of a pyrex tube is almost sealed by heating, and then pressed until flat and perpendicular to the axis. The inner and outer surfaces are ground, semi-polished and finally fire-polished. Examples quoted had hole diameters $\sim 0{\cdot}04$ mm and thickness $\sim 0{\cdot}09$ mm, giving an effusion of N_2 at 0·05 mm of $\sim 0{\cdot}3$ mg/day. T. G. H.

CHEMICAL PROCESSES 542.9

542.952.6 : 536.65

The heat and free energy of ethylene. *See Abstr.* 2482

CRYSTALLOGRAPHY 548

548.0 : 535

2793. Investigation of the excited states of colour centres. SILBERMANN, G. E. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 2) 135–45 (1949) *In Russian.*—The investigation of the *F*-centres is carried through on the method of excitation (in the limiting case of an almost inertialess polarized medium) and on Ritz's method. The first method yields possible self-consistent states, and the second enables their energies to be calculated. The existence is proved of a series of secondary (in accordance with their potential well) self-consistent states, and of a series of tertiary states. Radii of these states and their life-times are calculated, the latter being of the order of 10^{-6} sec, whereas the radii are sufficiently large to justify macroscopical consideration of the polarization. B. F. K.

548.0 : 535 : 537.312.5

2794. Time and temperature dependence of the photo-conductivity of coloured alkali-halide crystals. SILBERMANN, G. E. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 2) 146–54 (1949) *In Russian.*—[See Abstr. 2793 (1949)]. The investigation of the excited states of the *F*-centres makes it possible to study the kinetics of the processes of excitation, dissociation and recombination of the electrons. This leads to a determination of the time dependence of the photo-conductivity of the crystals in full qualitative agreement with experimental findings. The temp.-dependence of the photo-conductivity also agrees with experiments.

B. F. K.

548.0 : 535.34

Molecular theory of pleochroism in crystals. *See Abstr.* 2437

548.0 : 53

2795. Change in density of potassium chloride crystals upon irradiation with X-rays. ESTERMANN, I. LEIVO, W. J. AND STERN, O. *Phys. Rev.*, **75**, 627–3 (*Feb.* 15, 1949).—Alkali halide crystals become coloured when irradiated with X-rays. Theoretical considerations indicate that the coloration is due to absorption centres which consist of electrons trapped at negative ion vacancies. Precision measurements of the density of uncoloured crystals, however, indicate that it is very unlikely that there is a sufficient number of vacancies present in well annealed crystals to account for the number of colour centres, which may be determined optically, unless vacancies are formed as a result of the irradiation. KCl crystals were irradiated with X-rays. Their change in density was measured by the "crystal suspension method." It was found that the crystals changed in density, and that the number of vacancies calculated from the decrease in density was in reasonable agreement with the number of colour centres determined by optical measurement. A.

548.4 : 539.37

The mechanism of viscous intercrystalline slip. *See Abstr.* 2758

548.5

2796. Study of the kinetics of transformation of aragonite to calcite by isothermal dilatometry. PRUNA, M., FAIVRE, R. AND CHAUDRON, G. *C.R. Acad. Sci., Paris*, **227**, 390–1 (*Aug.* 9, 1948) *In French.*—The expansion occurring during the transformation of aragonite to calcite is measured at various temps. between 350 and 410°C. As the temp. is raised, the rate of transformation is increased, whilst the period of seed formation is reduced. Addition of calcite or isomorphous salts also increases the rate of transformation. The effect of rapid cooling during the periods of seed formation and transformation is discussed. J. A. F.

548.528 : 536.422 : 536.7

2797. Correction: On the range of validity of the Thomson–Gibbs equation. HONIGMANN, B., MOLIÈRE, K. AND STRANSKI, I. N. *Ann. Phys., Lpz.* (*Folge* 6) **2** (*Nos* 3–4) 182 (1948) *In German.*—See Abstr. 775 (1948). A. J. C. W.

MOLECULAR AND X-RAY CRYSTALLOGRAPHY 548.7

548.7 : 539.132

Forces of interaction in a molecular lattice. *See Abstr.* 2644

548.7 : 539.132

Discontinuous changes in distribution functions of molecules at a transition point. *See Abstr.* 2634

548.7 : 539.4

2798. A dynamical model of a crystal structure. II. BRAGG, L. AND LOMER, W. M. *Proc. Roy. Soc. A*, **196**, 171–81 (*March*, 1949).—A quantitative study of the mechanical properties of 2-dimensional bubble rafts has been made. The elastic properties have been used to check the theory of the interaction of the bubbles, and reasonable agreement is obtained. The plastic properties are the main subject of this paper. Plastic deformation proceeds by the motion of dislocations, and advantage has been taken of the possibility of making absolutely perfect crystalline rafts to study the production of dislocations. They are produced either in pairs in the body of the rafts, or singly from the edges. The shear strain required to produce them varies from 7° for bubbles of 2 mm diameter to a fraction of a degree for bubbles $< 0{\cdot}5$ mm diameter. The analogy with metals is best for bubbles of $\sim 1{\cdot}2$ mm diameter; for these the critical shear strain is $\sim 3°$. The observed shear strains can be explained in terms of the forces between the bubbles, and so it seems that the very low shear strengths of metallic single crystals cannot be explained in terms of dislocation creation, but must be a consequence of the initial presence of faults of some kind. A.

548.7 : 539.4

2799. A dynamical model of a crystal structure. III. LOMER, W. M. *Proc. Roy. Soc. A*, **196**, 182–94 (*March*, 1949).—A calculation of the maximum shear strain under which a two-dimensional close-packed lattice is stable has been carried out in terms of the forces between the lattice components. Two types of force were used; those between floating bubbles, which enabled a comparison with experiments on actual rafts of bubbles to be made, and also the forces derived from a potential $V = Ae^{-\beta r^2}$, which form has been frequently proposed as an approximation to the repulsive interaction terms between metal ions. The conclusion reached is that this maximum strain may be $<$ that deduced from a simple sine law approximation to the shear force versus displacement curve. Detailed consideration is given to edge effects in bubble rafts, and reasonable agreement with experimental results obtained. The overall result is that the formation of dislocations and consequent plastic yielding can occur in an initially perfect lattice only at quite large shear strains. The analogy with metals is discussed, and it is concluded that the low strengths of metallic single crystals are explicable only on the assumption that they are not perfect and that dislocations already exist in them and move under very small shear stresses. A.

548.73 : 539.264

X-ray measurement of the amorphous content of polythene samples. *See Abstr.* 2753

548.733

2800. A high-temperature X-ray camera for use with plate specimens. OWEN, E. A. *J. Sci. Instrum. Phys. Ind.*, **26**, 114–17 (*April*, 1949).—Describes the construction of an X-ray camera suitable for use with plate specimens at temps. up to about 1 000°C. The specimen rotates in its own plane and is at the same time oscillated through small angles about a vertical in its surface. To surmount difficulties arising from the orientation of the crystals in the specimen it is also arranged that the X-ray beam falls on the surface of the specimen at various glancing angles during the exposure. These movements and adjustments are executed when the specimen, during irradiation, is maintained at high temp. *in vacuo*. The temp. of the specimen is measured either by measuring the parameter of a standard substance whose thermal coeff. of expansion is accurately known and which is exposed to the X-rays simultaneously and under the same conditions as the specimen under examination, or by calibrating the furnace with standard substances. The part of the apparatus, the camera proper, on which the X-ray film is mounted can be removed for the processing of the film and replaced again after reloading without disturbing the rest of the apparatus. Samples of structure-spectra taken with a double specimen, Al and Ag, at different temps. are given. A.

548.733 : 537.531 : 621.386.26

Adjustable focus X-ray tube for crystallography. *See Abstr.* 2540

548.733 : 621.386

2801. Power supply for an X-ray tube used in conjunction with a Geiger counter spectrometer. ARNDT, U. W. *J. Sci. Instrum. Phys. Ind.*, **26**, 45–7 (*Feb.*, 1949).—The special requirements for power supplies feeding X-ray tubes used in conjunction with G.M.

counting equipment are discussed. The counting losses at high counting rates for the different types of h.t. supplies are compared, and an electronic stabilizing circuit is described. A.

548.734 : 539.26

2802. Limits of accuracy in the determination of lattice parameters and stresses by the Debye–Scherrer method. EKSTEIN, H. AND SIEGEL, S. *Acta Cryst.*, **2**, 99–104 (*April*, 1949).—The chief factor in limiting the presently attained accuracy of lattice-parameter determinations and stress evaluations by X-rays is the spectral width of the primary characteristic radiation. At large angles, where the line is most sensitive to changes of lattice dimension, the spectral width predominates over the width due to the geometry of the usual collimating systems. The accuracy of parameter determinations is limited essentially by the accuracy with which the centre of such a line can be measured. For a diffraction line with a smooth intensity distribution, recorded on film, the error of measurement caused by the irregular fluctuations of density arising from the film grain is determined experimentally. It is shown that the present accuracy of stress measurements by X-rays has, in favourable cases, reached the limit given by the spectral width of the characteristic radiation. A.

548.735.4

2803. Rapid method for calculating structure factors. BELOV, N. V. *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 3) 487–8 (1948) *In Russian.*—A simple nomogram of the cos or sin products *hx*, *ky*, *lz*, enabling the reflections *hko*, *hol*, *okl* to be determined very quickly, these being the ones used almost exclusively in structural analysis. The accuracy obtainable is 0·01, i.e. not less than that achieved by the Bragg–Lipson graphs. B. F. K.

548.735.4

2804. A third graphical method of indexing powder photographs of long-spacing compounds. VAND, V. *Acta Cryst.*, **1**, 290–1 (*Dec.*, 1948).—A graphical method of indexing X-ray powder photographs is described, suitable for compounds with identifiable long-spacing reflections. If the long axis is the *c* axis, all the reflections having the same *h* and *k* indices lie on the graph on a straight line. By this means all the possible solutions are displayed on the same graph, which can be prepared on a large scale, eliminating overcrowding and resulting in increased accuracy. A.

548.735.4

2805. Indexing powder photographs of orthorhombic crystals. LIPSON, H. *Acta Cryst.*, **2**, 43–5 (*March*, 1949).—A method of indexing powder photographs of orthorhombic substances is described and is illustrated by its application to KNO_3. A.

548.735.4

2806. The accuracy of electron-density maps in X-ray analysis with special reference to dibenzyl. CRUICKSHANK, D. W. J. *Acta Cryst.*, **2**, 65–82 (*April*, 1949).—Methods of correcting the systematic errors in electron-density maps due to using finite series of structure factors are discussed. Random errors in the maps are caused by experimental and computational rounding-off errors and by errors i the correction for finite series. Expressions a derived for the standard deviations of these rando errors, which have a Gaussian probability distributio It is shown how statistical significance tests can b used in the comparison of different bond-lengths, et These methods are illustrated by a detailed examina tion of the accuracy of the dibenzyl structure, whic confirms Jeffrey's conclusions on shortened centr bonds. Other topics include discussions of the shap of the atomic peaks in maps and the variation c errors with limiting reciprocal radii.

548.735

2807. A punched-card modification of the Beevers Lipson method of Fourier synthesis. HODGSON, M. L CLEWS, C. J. B AND COCHRAN, W. *Acta Cryst.*, 113–16 (*April*, 1949).—A description is given of method which has been used successfully for th evaluation of 2- and 3-dimensional Fourier series.

548.735.4 : 518

2808. An apparatus for the approximate calculatio of certain definite integrals in structure problem RODIER, G. *C.R. Acad. Sci., Paris*, **227**, 395– (*Aug.* 9, 1948) *In French.*—Describes a simple autc matic electrical method for the evaluation of th integral $\int_0^d f(x)\cos\left(\frac{2\pi rx}{d}+\phi\right)dx$, occurring in th determination of the distribution of intensity in th X-ray spectra of long-chain molecules of the fatt acid type. Values for the components of a workin model possessing an accuracy of 2–3% are given. H. P. M

548.735.

2809. Significance of the crystal dimension obtaine from the width of a Debye–Scherrer line. BERTAUT, F *C.R. Acad. Sci., Paris*, **228**, 187–9 (*Jan.* 10, 1949) *French.*—Formulae are derived, equivalent to thos of Waller [Abstr. 1576 (1942)], Stokes and Wilso [Abstr. 2628 (1942), 2315 (1944)] and Bouman an de Wolff [Abstr. 3217 (1947)]. It is shown that th apparent particle size can be expressed in the form $\varepsilon = \overline{T}(1 + \delta^2/\overline{T}^2)$, where T is the thickness of the crystal measured perpendicular to the reflectin planes, $\overline{T}$ is the mean value of T, and δ is the root mean-square value of $(T - \overline{T})$. A. J. C. W

548.735.

2810. The experimental determination of the soundness of crystals from X-ray and density measure ments. STRAUMANIS, M. E. *Acta Cryst.*, **2**, 82– (*April*, 1949).—A method is described which make possible the detection of imperfections in crystals o elements, compounds and solid solutions by the determination of molecular weights from X-ray and density measurements. Precision determinations o density and lattice constants are necessary for the calculations. It is shown that the elements Ag, Cu Fe, Pb, Te and the compounds LiF, $Pb(NO_3)_2$ and calcite may be considered as having a normal structure as the number of imperfect sites found does no exceed the possible error of determination of these imperfections. A normal structure is also shown by the tetragonal mixed crystals of the general formula

Zn, Cd, Co) $[Hg(CNS)_4]$ and by the α phase in solid solutions of the Ag–Zn system. A.

548.735.7 : 537.226

2811. Domain orientation in polycrystalline $BaTiO_3$. DANIELSON, G. C. *Acta Cryst.*, **2**, 90–3 (*April*, 1949).—X-ray diffraction patterns show that, below the Curie temp., the *c* axes of some of the individual crystallites can be oriented by large electric fields into a direction normal to their original direction and more nearly parallel to the applied field. For a field of 24 kV/cm^{-1} applied 35°c below the Curie temp. about 80% of the material was oriented so that the *c* axis made an angle of $< 45°$ to the electric field. At temps. considerably above the Curie temp. the electric field had no effect; but at temps. just above the average cubic-tetragonal transition temp., the electric field appeared to increase the number of non-isometric crystals. A.

548.736

2812. Crystal chemical studies of the 5*f*-series of elements. III. A study of the disorder in the crystal structure of anhydrous uranyl fluoride. ZACHARIASEN, W. H. *Acta. Cryst.*, **1**, 277–81 (*Dec.*, 1948).

548.736

2813. Crystal chemical studies of the 5*f*-series of elements. IV. The crystal structure of $Ca(UO_2)O_2$ and $Sr(UO_2)O_2$. ZACHARIASEN, W. H. *Acta Cryst.*, **1**, 281–5 (*Dec.*, 1948).

548.736

2814. Crystal chemical studies of the 5*f*-series of elements. V. The crystal structure of uranium hexachloride. ZACHARIASEN, W. H. *Acta Cryst.*, **1**, 285–7 (*Dec.*, 1948).

548.736

2815. Crystal chemical studies of the 5*f*-series of elements. VI. The Ce_2S_3–Ce_3S_4 type of structure. ZACHARIASEN, W. H. *Acta Cryst.*, **2**, 57–60 (*March*, 1949).

548.736

2816. Crystal chemical studies of the 5*f*-series of elements. VII. The crystal structure of Ce_2O_2S, La_2O_2S and Pu_2O_2S. ZACHARIASEN, W. H. *Acta Cryst.*, **2**, 60–2 (*March*, 1949).

548.736

2817. Crystal chemical studies of the 5*f*-series of elements. VIII. Crystal structure studies of uranium silicides and of $CeSi_2$, $NpSi_2$ and $PuSi_2$. ZACHARIASEN, W. H. *Acta Cryst.*, **2**, 94–9 (*April*, 1949).—Crystal structures are deduced for the compounds α-USi_2, $NpSi_2$, $PuSi_2$, $CeSi_2$, β-USi_2, USi, U_3Si_2 and U_3Si. Each Si atom forms 3 covalent bonds with other Si atoms in the disilicides, 2 such covalent bonds in USi, one in U_3Si_2 and none in U_3Si. The various crystal structures and observed interatomic distances are discussed in some detail. A.

548.736.3

2818. The crystal structure of hexagonal barium titanate. BURBANK, R. D. AND EVANS, H. T., JR. *Acta Cryst.*, **1**, 330–6 (*Dec.*, 1948).

548.736.3

2819. Unit cell dimension of face-centred cubic chromium hydride and space groups of two chromium hydrides. SNAVELY, C. A. AND VAUGHAN, D. A. *J. Amer. Chem. Soc.*, **71**, 313–14 (*Jan.*, 1949).—A determination of the lattice parameter of F.C.C. chromium hydride is reported. The new value is $a = 3{\cdot}8605 \pm 0{\cdot}0005$ Å. Structures are postulated for the F.C.C. and H.C.P. chromium hydrides and an argument is presented to refute the concept that chromium is allotropic. A.

548.736.4

2820. The crystal structure of zirconium oxysulfide, ZrOS. MCCULLOUGH, J. D., BREWER, L. AND BROMLEY, L. A. *Acta Cryst.*, **1**, 287–8 (*Dec.*, 1948).

548.736.4

2821. The crystal structure of groutite, $HMnO_2$. COLLIN, R. L. AND LIPSCOMB, W. N. *Acta Cryst.*, **1**, 104–6 (*April*, 1949).—The dimensions of the orthorhombic unit cell are $a = 4{\cdot}58$ Å, $b = 10{\cdot}76$ Å and $c = 2{\cdot}89$ Å, and the space group is D_{2h}^{16}–*Pbnm*. The atomic arrangement is very nearly identical with that of diaspore. A.

548.737

2822. The crystal structure of gammexane. BIJVOET, J. M. *Rec. Trav. Chim. Pays-Bas*, **67**, 777–82 (*Nov.*, 1948) *In English. Also Nature, Lond.*, **162**, 771 (*Nov.* 13, 1948).—X-ray analysis of the crystals of gammexane, 1,2,3,4,5,6-hexachlorocy clohexane, proves this isomer to be of the p,p,p,e,e,e type. A.

548.737

2823. The crystal structure of dibiphenyleneethylene. FENIMORE, C. P. *Acta Cryst.*, **1**, 295–303 (*Dec.*, 1948).

548.737

2824. The crystal structure of hexamethylenediamine and its dihalides. Hexamethylenediamine dihydrobromide. BINNIE, W. P. AND ROBERTSON, J. M. *Acta Cryst.*, **2**, 116–19 (*April*, 1949).

548.737

2825. The crystal structure of diethyl terephthalate. BAILEY, M. *Acta Cryst.*, **2**, 120–6 (*April*, 1949).

548.737 : 539.133

Structure of diphenyl. *See Abstr.* 2645

548.74

2826. Electron diffraction structure analysis of $BaCl_2$. WEINSTEIN, B. K. *Dokl. Akad. Nauk, SSSR*, 60 (*No.* 7) 1169–71 (1948) *In Russian.*—The structure was found to consist of a face-centred Ba lattice with two similar Cl lattices, displaced by, respectively, $\pm \frac{1}{4}$ of the body diagonal. The distance Ba–Cl is 3·18 Å, and the sum of the ionic radii 3·24 Å. Their difference, $\Delta = 0{\cdot}06$ Å, is of the order typical for all halides of 2-valent metals crystallizing on the fluorite lattice model. B. F. K.

548.74

2827. The electron microscopy of macromolecular crystals. WYCKOFF, R. W. G. *Acta Cryst.*, **1**, 292–4 (*Dec.*, 1948).—A survey of recent applications of electron microscopy to the direct study of the molecular structure of macromolecular solids. The arrangement of molecules in a number of proteins is shown and evidence is obtained on the molecular constitution of the faces of crystals of these materials. A.

GEOPHYSICS 55

550.34

2828. Diminution of the earth tremors caused by explosion. LANGFORS, U. *Tekn. Tidskr.*, **79**, 141–8 (*Feb.* 26, 1949) *In Swedish.*—A vibrograph using a capacitor pick-up with a c.r.o. is described. The theory of waves in a solid finite medium, generated by explosions, is given and surface and volume waves are considered. The effect on buildings of these waves is discussed and theory and experience are compared. It has been found that a series of short-interval explosions of a given charge causes much less damage than a single firing of the same total charge. A combined series-parallel circuit for firing at const. intervals of 30–40 msec is described. Oscillograms of tremors due to such successive explosions are shown, and photographs of the effect of the explosion in the quarry. J. A. W.

550.341 : 534.647

2829. On the theory of seismometers. II. PENDSE, C. G. *Phil. Mag.*, **39**, 985–8 (*Dec.*, 1948).—Extensions and corrections to previous work [Abstr. 542 (1945)]. The different equilibrium positions of a seismometer are considered and the case of the vertical seismometer is discussed in detail. L. S. G.

550.38 : 538.12

Electron orbits in the earth's magnetic field. *See Abstr.* 2602

550.38 : 591.185.63

Sensitivity of homing pigeon to earth's magnetic field. *See Abstr.* 2842

550.38 : 621.318.381

2830. Compass compensating coils. ROBINSON, R. A. *Elect. Engng, N.Y.*, **68**, 11 (*Jan.*, 1949) [Digest of *Amer. Inst. Elect. Engrs* Paper **48–228** to be published in *Trans.* **67** (1948)].—An account of methods of compensating ships' magnetic compasses for the effects of degaussing coils used on the ships during the war. See Abstr. 409 B (1947).

550.837 : 537.222

Field of a point source of current situated on the earth's surface above an inclined stratum. *See Abstr.* 2490

ATMOSPHERE . METEOROLOGY 551.5

551.508 : 551.576

2831. Cloud observations from rockets. CROWSON, D. L. *Bull. Amer. Met. Soc.*, **30**, 17–22 (*Jan.*, 1949).—Photographs of cloud formations over 500 000 sq. miles of S.W. U.S.A. from a V.2 rocket at heights of up to 100 miles are analysed and compared with weather maps for the region. The potentialities of rocket photographs or television for meteorology are pointed out.

551.51 : 532.511

A systematic treatment of moving axes in hydrodynamics. *See Abstr.* 2354

551.51 : 532.511

Two dimensional fluid motion referred to a network of orthogonol curves. *See Abstr.* 2355

551.510.4 : 535.343.4 : 523.

CH_4 in earth's atmosphere. *See Abstr.* 2300

551.510.535 : 523.5 : 531.5

2832. Ballistics of the upper atmosphere. JACCHI L. G. *Tech. Report No.* 2, *Harvard Coll. Obs. a M.I.T. Center of Analysis*, 1–30 (1948).—The res tance equation for meteor motion in the upp atmosphere is derived and 60 values of air density a obtained from observed decelerations of 37 meteo The densities are subject to seasonal variations, ma and min. being coincident with the max. and min. mean ground temp. The amplitude of the fluctuatio which amounts to a factor of 2·5 at 70 km, appea to decrease with height. The results are mu closer to NACA data than to V2 measurements.

551.510.535 : 621.396.1

2833. Studies on the ionosphere at Calcutt BARAL, S. S. *J. Sci. Indust. Res.*, **7**, 59–70 (*Fe* 1948).—The results of normal incidence ionospher measurements made at Calcutta during Aug., 194 Aug., 1947, are plotted as monthly mean hour values. Some data on sporadic *E*-reflections are als given. W. J. G. B. (

551.510.535 : 621.396.11 : 621.314.2

2834. Ionosphere reflections recorded mechanicall by means of a repetition frequency convertor. STOF REGEN, W. *Forsvarets ForsknInst. Arb.*, 178–8 (1947) *In English.*—The method is based on scannin the 50 c/s echo pattern with an artificial 4 sec puls the scanning pulse being periodically displaced by phase-adjusting device. The phase variation of th pulse is synchronized with the movement of the pe on the recorder. Diagrams, illustrations of th apparatus and record specimens are given.

J. A. W. (R

551.57

2835. Evaporation in nature. PENMAN, H. L *Rep. Phys. Soc. Progr. Phys.*, **11**, 366–88 (1946–47).— The earlier part of the paper provides a summary c data on evaporation of a historical nature. From a aerodynamical approach to the theory of evaporatio the mean daily evaporation rate, E, is given b $E \simeq 0{\cdot}017(e_s - e_d)B$ in/day where e_s and e_d are i mm Hg and B is the Beaufort wind force. Evapora tion measurements obtained by various sources fo open water, bare soil and cropped soil in homogeneou and catchment areas are examined and the result discussed in terms of the theories used. R. S. P

551.593.5/.7 : 535.4

2836. Theory of the diffraction of light on admixture in the atmosphere and hydrosphere. SHIFRIN, K. S *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 3) 483–5 (1948 *In Russian.*—The author's treatment starts fro Maxwell's equations which, by aid of Hertz's vecto are transformed into an integral equation determinin the volume distribution of the effective electric fiel within and without the diffracting particles. The integral equation consists of 3 terms correspondin to the field due to (1) external light sources, (2) the polarized volume elements of the spherical particle and (3) to the screening (fictitious) charges on the surface of the sphere. In the static case the latter contributio exactly compensates the polarization field and

herefore, the effective field within the sphere corresponds to that without. The author then proceeds to solve the integral equation by successive approximations, i.e. expansions in terms of α, a parameter depending on the electric polarization. The first approximation yields Rocard's formulae, and in a limiting case, Rayleigh's formula. The domain of applicability of the 1st approx. is found from a criterion supplied by the energy flux formula. The given method is not confined to particles of spherical shape but may be applied without any particular difficulty to any particle form, and represents a considerable simplification compared with the known methods. B. F. K.

551.594.221 : 537.523.4

2837. The mechanism of lightning discharge. LOEB, L. B. *J. Franklin Inst.*, **246**, 123–48 (*Aug.*, 1948).—A summarizing account is given of some recent work on the mechanism of the laboratory spark discharge in a homogeneous field. The ionization phenomena governing the electron avalanche are discussed and illustrated by cloud-chamber photographs. The physical mechanism of the streamer advance is described. The breakdown mechanism in long sparks is discussed both for positive and negative point electrodes and the characteristics of the 2 principal types of lightning leader stroke summarized. The development of the stepped and dart leader stroke and the occurrence of upward streamers from ground are discussed and the occurrence of multiple-stroke flashes examined. R. H. G.

551.594.25

2838. Atmospheric electricity during disturbed weather. SIMPSON, G. C. *Terr. Magn. Atmos. Elect.*, **53**, 27–33 (*March*, 1948).—An investigation undertaken at Kew Observatory during the war, of the electricity carried on rain and snow. Recordings were made, for each minute during periods of disturbed weather, of potential-gradient, point-discharge, rain-current, charge per cm^3 carried by the rain, and rainfall rate. Among the conclusions, one is that the characters of the potential-gradient and the rainfall are governed by the character of the air-motion in the upper atmosphere. The association of disturbed potential-gradient with rainfall is not that of cause and effect, but that of two secondary effects of the air motion. Potential-gradient patterns (when plotted against time) are another feature of disturbed weather, but not always with precipitation at the ground, and some are associated with definite types of weather. A. C. C.

551.594.5 : 535.333

2839. The intensity distribution in the nitrogen band systems emitted from the earth's upper atmosphere. BATES, D. R. *Proc. Roy. Soc. A*, **196**, 217–50 (*March*, 1949).—The intensity distributions in the negative and first and second positive band systems of N are determined for a number of excitation mechanisms. The results are compared with the intensity distributions observed from upper atmospheric sources. Ordinary aurorae are discussed in detail. It is shown that if the emission is attributed to electron excitation then it is necessary to assume vibrational temperatures of many thousand degrees. A more plausible interpretation is that heavy particles, often considered to form part of incident auroral streams, contribute to the excitation. High and low latitude aurorae show striking differences. The emission of the negative band system from sunlit aurorae and from the twilight sky is studied. The direct action of the solar radiation on N ions is responsible. In the case of sunlit aurorae the continued absorption and emission of the resonance bands raises the vibrational temperature of the ions: this greatly influences the intensity distribution. The consequences of the identification of the strong infrared emission from the nocturnal sky with the (0, 0) band of the first positive system is discussed. It would appear that the identification necessitates a high degree of dissociation of the upper atmospheric N. Confirmatory observational work is urged. In the appendix a preliminary investigation on the energy distribution of electrons in aurorae is attempted. A.

551.594.6 : 621.396.11.029.58

2840. Short-wave communication. Determination of the available frequency range. LIED, F. *Forsvarets ForsknInst. Arb.*, 49–68 (1947) *In Norwegian.*—Discussion of ionosphere properties, height of layers and max. electron density, leads to an expression for max. frequency of electromagn. waves for a given skip distance. Damping is discussed, together with multiple reflection and atmospheric noise, and the observations at Slough, Washington, Watheroo and Huancayo are summarized. Organization of observations is described and the disturbances of solar and terrestrial-magnetic origin are discussed. A numerical example is given. J. A. W. (R)

BIOLOGY 57/59

578

2841. Sampling devices for determining the bacterial content of air. LUCKIESH, M., TAYLOR, A. H. AND KNOWLES, T. *Rev. Sci. Instrum.*, **20**, 73–80 (*Jan.*, 1949).—Two types of impinger samplers have been developed. One, weighing 12 lb, employs an electrostatic field of about 7 000 V and can be used wherever 110–120 V, 60-cycle current is available. The other, a duplex radial-jet air sampler, uses a high velocity air flow to impinge the organisms on the culture medium. Examples of the use of the latter sampler in laboratory studies are described and typical experimental results are presented. A.

591.185.63 : 550.38

2842. Sensitivity of the homing pigeon to the magnetic field of the earth. LANDSBERG, H. *Science*, **108**, 710–11 (*Dec.* 24, 1948).—Theoretical criticisms of Yeagley's magnetic theory [Abstr. 1132 (1948)] of the mechanism of navigation in homing pigeons are reviewed, and a repetition of Yeagley's experiments is described. 24 birds carried magnets, 24 carried similar unmagnetized bars and 12 carried no weights. Birds were released 36–58 miles from the aviaries. All birds returned before nightfall and the experiment failed to show any effect due to the attachment of magnets. E. E. C.

MEDICAL SCIENCE . HUMAN PHYSIOLOGY 61

612.84 : 535.14

2843. Light quanta and vision. DE VRIES, H. Letter in *J. Opt. Soc. Amer.*, **39**, 201–2 (*Feb.*, 1949).

615.849 : 621.386.1

2844. Proposed X-ray tube with annular anode and diaphragmed window for increasing the depth dose in radiotherapy. BOSSI, R. *Acta Pont. Acad. Sci.*, **11** (*No.* 10) 117–32 (1947) *In Italian.*—The use of a tube of novel design is discussed. See also Abstr. 476 B (1947). It is claimed that the delivery of a converging beam of radiation through an annular skin field approximates to the ideal of Chaoul when the ratio of dose volume to total volume irradiated approaches unity. In reality this ratio is 25% for short-distance X-ray therapy, 3% for contact radium therapy, 1·6% for rotational X-ray therapy and 0·1% for whole body irradiation. Another advantage claimed is longer life of tube, due to (*a*) decreased loading of 1 W/sec/mm of tungsten target, compared with 75 W of existin therapy tubes, and (*b*) simplification of cooling.

T. A. C. (

616–073.75 : 778.3

2845. The use of roentgen rays in body measure ments. A mathematical method. Preliminary repor MANGANIELLO, L. O. J. *Amer. J. Roentgeno Radium Ther.*, **60**, 664–7 (*Nov.*, 1948).—A method described for localization of embedded bodies an measurement of their dimensions, based on th principles of analytical solid geometry, a formu being derived in terms of distances between 2 poin defined by Cartesian co-ordinates. This formula then applied practically by the determination of th length of a file placed in any arbitary positio the double image with tube shift being shown. Th length found was 21·3 cm, for an actual length 21 cm, which is a fair accuracy for such determina tions.

B. J.

PHOTOGRAPHY 77

77.012

2846. Latent image formation in photographic silver halide gelatine emulsions. BERG, W. F. *Rep. Phys. Soc. Progr. Phys.*, **11**, 248–97 (1946–47).—A review on present theories and experimental evidence on the subject is given. The physical and chemical nature of the latent image and its formation, the mechanism of development and photographic phenomena in terms of the Gurney–Mott theory are discussed in detail.

R. H. H.

771.36 : 621.317.39

2847. Camera shutters. KATZ, A. H. *J. Opt. Soc. Amer.*, **39**, 1–21 (*Jan.*, 1949).—The characteristics of between-lens, focal-plane and of louvre shutters are reviewed, and the important distinction between effective exposure time and actual (or motion-stopping) exposure time is clarified. The oscillographic test method for between-lens shutters is described and depicted via photograph and schematic diagram. The strobotac and drum tester methods for focal plane shutters are summarized, as is a method for testing louvre shutters. The effect of inefficient between-lens shutters on optical performance, effect of a glass pressure plate on efficiency of focal-plane shutters, and equations for the two types of distortion caused by focal plane shutters are discussed. The utilization and advantage of shutter speed in aerial cameras to reduce the deteriorative effects upon definition caused by forward aircraft speed, angular motion of the aircraft about its axis, and camera vibration are discussed. The shutterless strip camera and the corollary principle of image speed compensation with moving-film magazines in conventional cameras, and the potentialities of this important new development, are described. A list of seventeen memorandum reports, which cover in detail the work summarized in this paper, is appended.

A.

771.44 : 535.89

2848. Characteristic of photoflash lamps. MURGAI, M. P. *J. Sci. Indust. Res.*, **8**, 44–50 (*Feb.*, 1949).

771.531 : 537.534 : 539.16

Grain density in photographic tracks of heav particles. *See Abstr.* 2699

771.535.1 : 539.1

2849. On the mechanism of fading of nuclea research plates. ALBOUY, G. AND FARAGGI, H. *C.R. Acad. Sci., Paris*, **228**, 68–70 (*Jan.* 3, 1949) *In French.*— The rate of latent image fading in nuclear trac emulsions is influenced by a variety of factors, which the following have been investigated: humidity loading, temp., H_2O_2 and vacuum. The rate of fading with humidity decreases exponentially wit the quantity of H_2O retained in the gelatin of th emulsion. Loading tests show that salts increasin the *p*H of the emulsion act as sensitizers and sal decreasing the *p*H accelerate fading. Latent imag fading of plates in vacuum and in inert gases negligible, whereas the rate of fading in O is 2 time as great as in air and 10 times as great as in N. Th fading effect is believed to be an oxidation proce due to the O of air. An interpretation based on th recent theory of latent image formation by Mitche is given.

R. H. I

777.3 : 537.53

Recording electron tracks in photographic emulsion *See Abstr.* 2542

778.33 : 616–073.7

X-rays in body measurement. *See Abstr.* 2845

778.5 : 628.978 : 621.32

2850. Electronic flashtube illumination for specia ized motion picture photography. LESTER, H. M *J. Soc. Mot. Pict. Engrs*, **50**, 208–32 (*March*, 1948).— Describes two equipments designed for making motio pictures by means of repetitive flashing of flash-tube using standard motion-picture cameras. Differe designs of tubes are used, including a circular tube a parabolic trough reflector bent into a circl Short bursts at a rate of 24 frames/sec are used b the life of the tube is very short. Details of exposu values for different types of film are given and son details of the electrical side of the apparatus a included.

J. W. T. W. (